NOVEMBER 1954

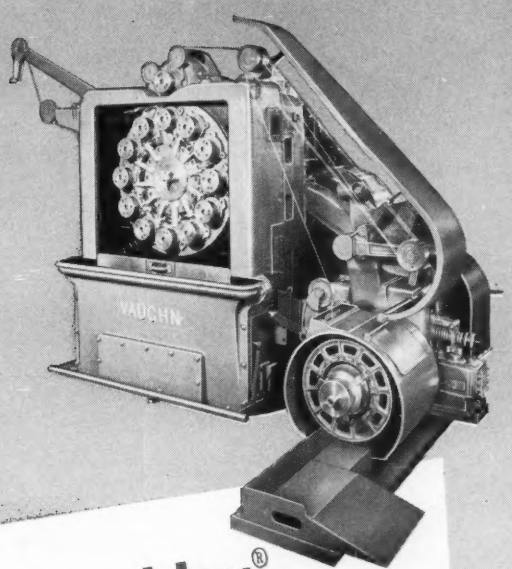
WIRE AND WIRE PRODUCTS

Vaughn®

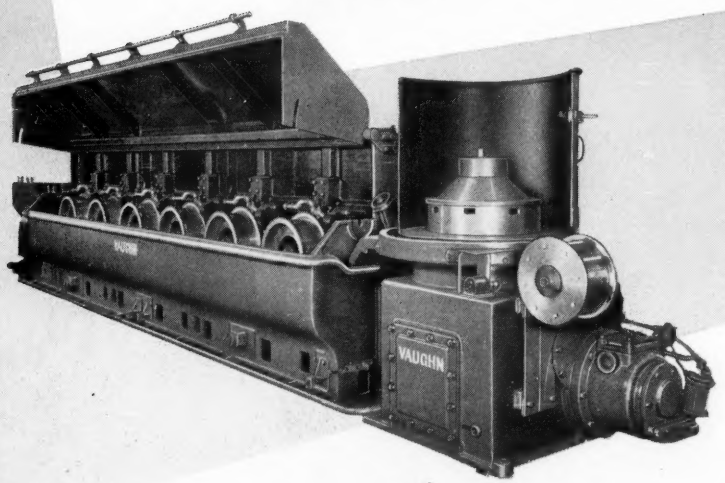
THE ONLY MANUFACTURER
BUILDING A COMPLETE LINE OF

Tandem Machines

FOR DRAWING NON-FERROUS WIRE
(ALUMINUM, COPPER, ALLOY)



Ringblox®
(Circular Tandem)
FOR INTERMEDIATE
AND FINE WIRE



Straight Tandem Types
FOR COARSE WIRE

V® "Quick on the Draw!"

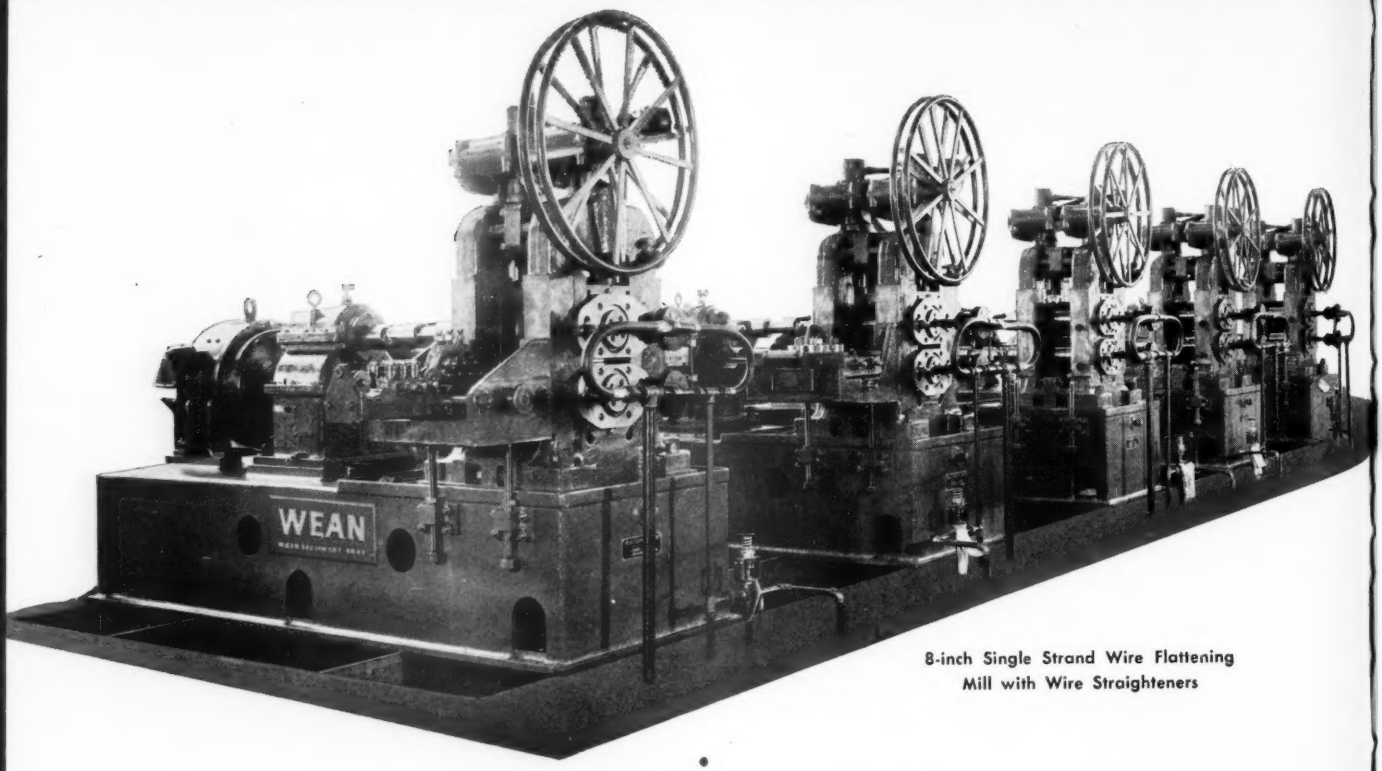
Vaughn Tandem Machines provide modern speed and versatility in drawing non-ferrous wire, combined with the engineered dependability that reflects Vaughn's many years of specialization in this field. Details? Gladly—at your convenience.

The Vaughn Machinery Co.
CUYAHOGA FALLS, OHIO, U.S.A.

COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

Wean



8-inch Single Strand Wire Flattening Mill with Wire Straighteners

A COMPLETE ENGINEERING SERVICE FOR WIRE MILL INSTALLATIONS

Complete Installations for Electro Galvanizing, Hot Dip Galvanizing, Patenting, Tinning, Wire Flattening, Nail Galvanizing and Blueing.

Complete Equipment for the Manufacture of Hexagon Netting, Hinge Joint Fence and Barbed Wire.

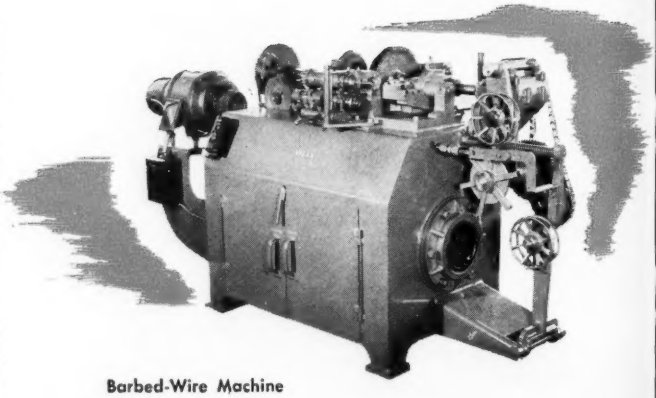
CHECK WEAN FIRST FOR WIRE MILL EQUIPMENT

STRIP MACHINERY

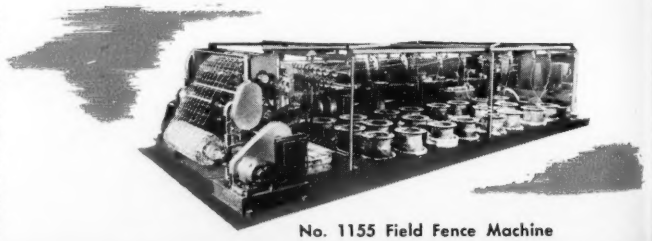
Slitting Installations. Cut to Length Installations. Bearing Metal Coating Installations. Two-Hi Rolling Mill Applications. Strip Grinding Installations. Levelers, Uncoilers, Pinch Rolls, Shears for Strip Processing lines.

WEAN EQUIPMENT CORPORATION

22800 LAKELAND BLVD. • CLEVELAND, OHIO



Barbed-Wire Machine



No. 1155 Field Fence Machine

Wean *Equipment Corporation*

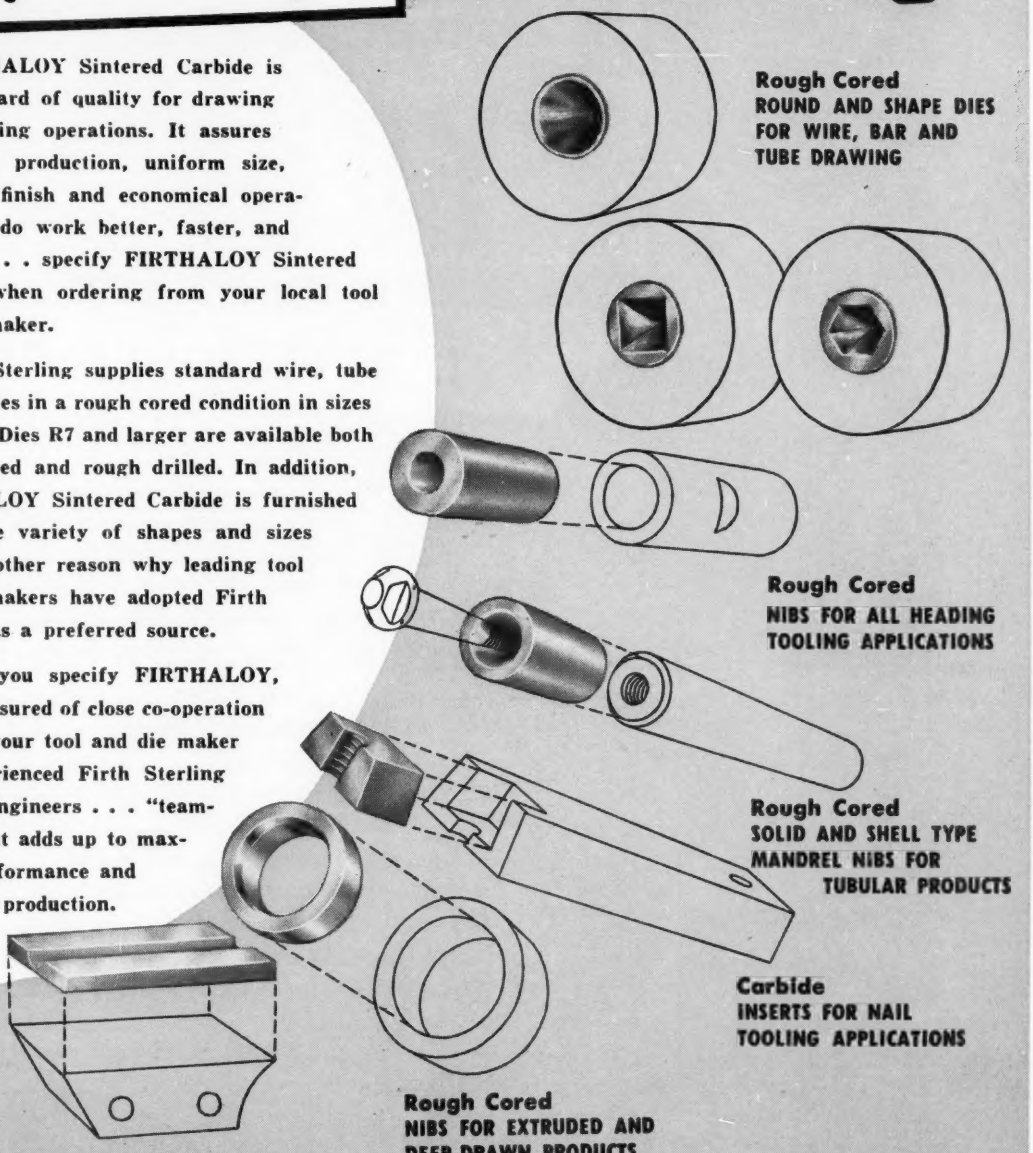
CLEVELAND, OHIO

Specify Firthaloy

FIRTHALOY Sintered Carbide is the standard of quality for drawing and forming operations. It assures maximum production, uniform size, excellent finish and economical operation. To do work better, faster, and cheaper . . . specify FIRTHALOY Sintered Carbide when ordering from your local tool and die maker.

Firth Sterling supplies standard wire, tube and bar dies in a rough cored condition in sizes up to R7. Dies R7 and larger are available both rough cored and rough drilled. In addition, FIRTHALOY Sintered Carbide is furnished in a wide variety of shapes and sizes . . . . another reason why leading tool and die makers have adopted Firth Sterling as a preferred source.

When you specify FIRTHALOY, you are assured of close co-operation between your tool and die maker and experienced Firth Sterling Service Engineers . . . "teamwork" that adds up to maximum performance and increased production.



Rough Cored
ROUND AND SHAPE DIES FOR WIRE, BAR AND TUBE DRAWING

Rough Cored
NIBS FOR ALL HEADING TOOLING APPLICATIONS

Rough Cored
SOLID AND SHELL TYPE MANDREL NIBS FOR TUBULAR PRODUCTS

Carbide
INSERTS FOR NAIL TOOLING APPLICATIONS

Rough Cored
NIBS FOR EXTRUDED AND DEEP-DRAWN PRODUCTS

Carbide
FOR SPRING FORMING TOOLS AND WEAR-RESISTANT PARTS

R-294

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—INC—
GENERAL OFFICES: 3113 FORBES ST., PITTSBURGH 30, PA.

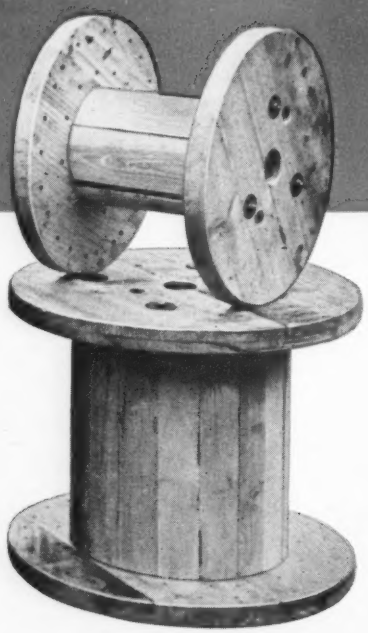
OFFICES* AND WAREHOUSES: BIRMINGHAM* CHICAGO CLEVELAND DAYTON* DETROIT HARTFORD HOUSTON* LOS ANGELES NEW YORK* PHILADELPHIA* PITTSBURGH* WASHINGTON* WESTFIELD, N.J.*

PRODUCTS OF FIRTH STERLING METALLURGY

High Speed Steels
Tool & Die Steels
Stainless Specialties
High Temperature Alloys
Sintered Tungsten Carbides
Firth Heavy Metal
Chromium Carbides
High Temperature Cermets

WE have EXPANDED!

in order to offer YOU...



1. BETTER SERVICE
2. FINER QUALITY
on
WOOD REELS
AND WOOD HEADS FOR STEEL DRUMS
for
CABLE · ROPE · WIRE

THIS IS WHAT WE HAVE DONE IN THE LAST YEAR TO GIVE YOU BETTER REELS AT LOWER COST:

- Considerably expanded the plant floor space.
- Equipped it completely with new machinery.
- Built new modern kilns for drying lumber.
- Added more trucks to the delivery fleet.
- Installed modern material handling equipment in buildings and yards.
- Paved over 6 acres of lumber yard space—which accommodates millions of board feet of lumber for reel manufacture only.

HIGH SPEED
SHIPPING SERVICE in our... OWN TRUCKS
within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels in 5 days or less east of the Mississippi.

BRIDGE
MANUFACTURING COMPANY
HAZARDVILLE, CONNECTICUT

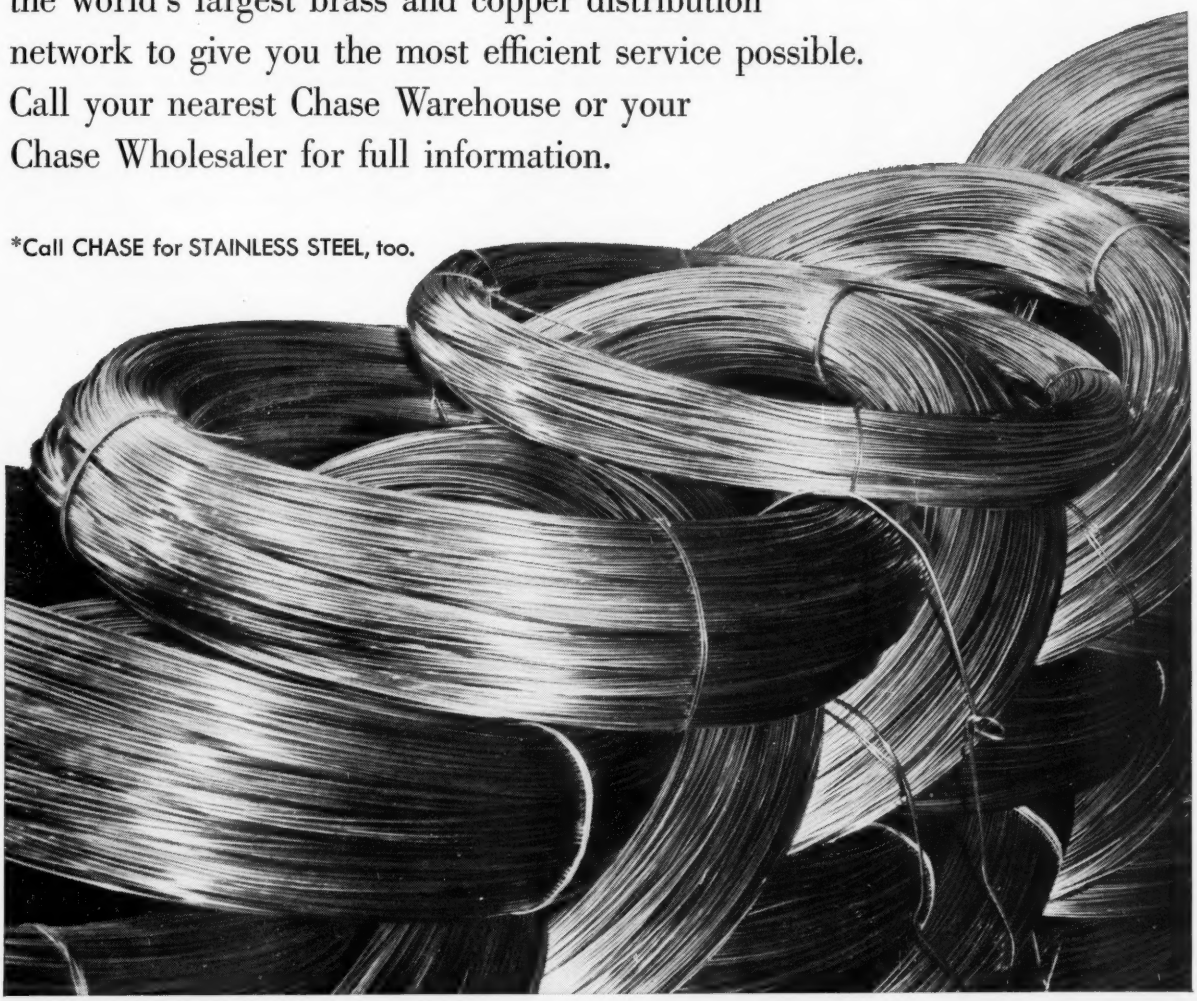
Telephone . . .
Thompsonville, Connecticut
RIverview 9-8308

"REAL GOOD..."
Let us quote on your reel needs. Send your specifications. Better yet, visit our plant and see how and why our reels are made so well at so low a cost.
WOOD REELS"

Quality Wire . . . Quick Service!

CHASE Copper Alloy* Wire is quality wire—*strictly uniform* in temper, in gauge, texture, color. It comes in a wide variety of sizes, alloys, colors, tempers to fit your needs. And... when you order it, you get it *fast!* For Chase maintains the world's largest brass and copper distribution network to give you the most efficient service possible. Call your nearest Chase Warehouse or your Chase Wholesaler for full information.

*Call CHASE for STAINLESS STEEL, too.



Chase ®

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

NEW PRIZE-WINNING MOVIE—"*The Science of Making Brass.*" Available for free showing in your plant or office, or to industry groups. Call nearest Chase warehouse or write us.

The Nation's Headquarters for Brass & Copper

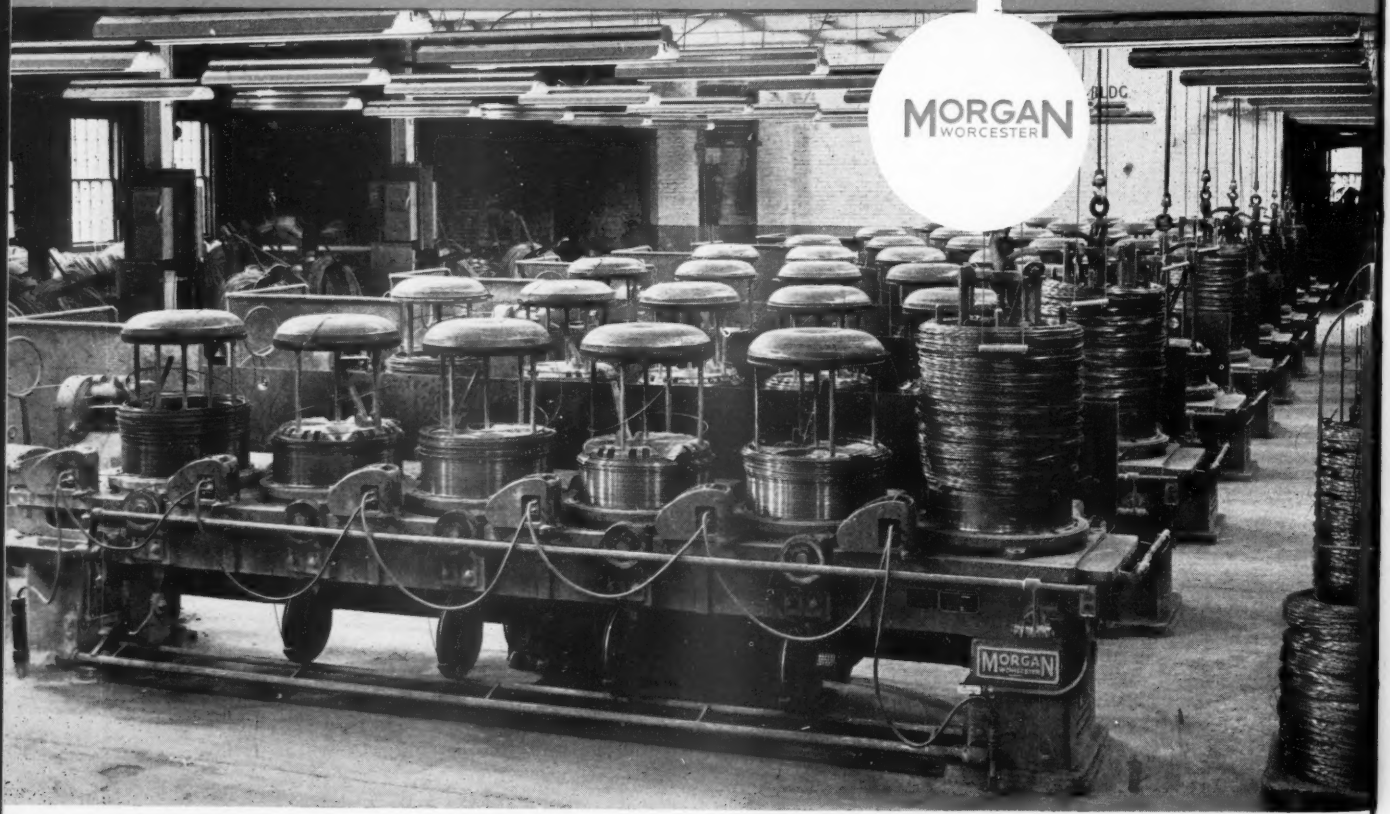
Albany†	Chicago	Denver†	Kansas City, Mo.	Newark	Pittsburgh	San Francisco
Atlanta	Cincinnati	Detroit	Los Angeles	New Orleans	Providence	Seattle
Baltimore	Cleveland	Houston	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

Outstanding Results

Recently we announced the results of a series of scientific tests on the temperatures of wire while being drawn. The tests showed the results of reducing wire temperatures by air cooling to be outstanding.

Recent installations of new Morgan-Connors are confirming—in actual mill production—the results shown by our tests.

Photo courtesy Wickwire Spencer Steel Division, Palmer, Massachusetts



MORGAN-CONNOR

WIRE MACHINES

MORGAN CONSTRUCTION COMPANY • WORCESTER, MASSACHUSETTS

WM76

WIRE AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 29 November, 1954 No. 11

Designated as Official Publication By The Wire Association

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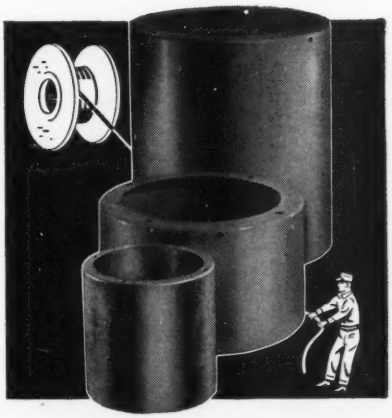
REPUBLIC

FLANGED STEEL TRAVERSES



are:

1. Light in weight
2. Durable
3. Strong
4. Easy to assemble
5. Smooth—free from rough spots that might damage plastic-covered cable.

Made in sizes up to 56-inch diameter and 48-inch traverse—in plain, painted or hot dip galvanized finish—as light as 18-gauge steel. Width of flange and number of bolt and drain holes furnished to your specifications. Available for prompt delivery. Write for prices.

* * *

Manufactured under license arrangement with Western Electric Co., Inc.

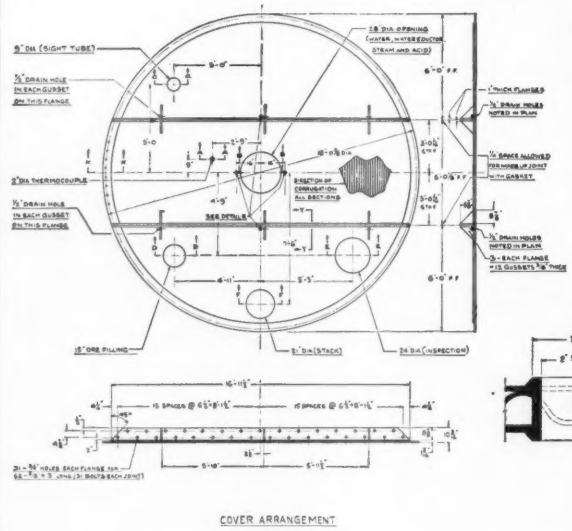
REPUBLIC STEEL

REPUBLIC STEEL CORPORATION
Pressed Steel Division • Niles, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Building, New York 17, New York

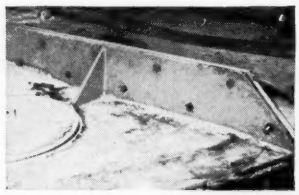
consult HAVEG . . . America's first molder of corrosion-resistant plastic equipment

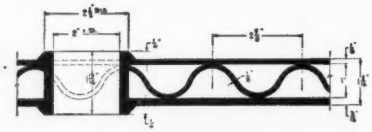
P-G TANKS for metal finishing withstand acid attack, are non-conductors of electricity, can take hard knocks.

P-G FUME DUCT is molded into complete fume removal systems. Duct is easily installed, does not require elaborate supports.



COVER ARRANGEMENT





SECTION A-A
AND TYPICAL ALL OVER CONSTRUCTION

HAVEG BUILT THIS P-G COVER FOR AN ACID STORAGE TANK. It replaced a wooden one with a service life of less than a year. A special corrugated reinforcement (see Section A-A) also of P-G, increased the cover's strength, reduced the weight. From design to installation, Haveg engineers worked closely with the plant engineers, made sure by return inspection that true value had been received. In fact, the customer recently ordered another P-G cover for an adjacent tank in the same service.

FOR COOLING TOWERS • FUME DUCT • TANKS • COVERS • LININGS • PIPE

of P-G laminated polyester glass

Both users and manufacturers of cooling towers, and similar structures subject to corrosive liquids and gases, can profit by relying on the accumulated engineering skill of the Haveg Corporation, which is now making polyester glass laminated plastic equipment.

Polyester glass is lightweight, low-cost, easy to fabricate and install. It resists many corrosives. Haveg P-G (polyester-glass) products are satisfactory for continuous operation at temperatures about 200°F., and for intermittent service as high as 240°F.

Molding plastics into corrosion-resistant equipment is not a new venture for Haveg. Over twenty years ago Haveg introduced a new plastic material . . . Haveg . . . made from acid-digested asbestos mixed with special Haveg resins. Haveg has been made into the biggest molded plastic tanks in the world, into a 200′ high fume stack, into giant petrochemical installations.

Like any other construction material, Haveg 41 and 60 and the new P-G materials sometimes present problems in design, manufacture, installation, or economics of selection. In the end, the purchaser must rely on the experience and reputation of the supplier. So Haveg makes these promises:

1. Polester glass will be recommended and supplied only after complete testing and full consultation with your plant engineers.

2. Haveg will use its broad experience in fighting corrosion to tell you if P-G is the best material. A reference file of installations plus systematic progress reports where available will be a valuable source of information.

Haveg P-G is new. It promises good dividends in many applications. But it calls for close cooperation between Haveg and the user. Call the Haveg sales engineer listed. Tell us your problem . . . together we will find if Haveg P-G fits your needs!

ATLANTA, Exchange 3821 • CHICAGO 11, Delaware 7-6088
CINCINNATI 36, Sycamore 2600 • CLEVELAND 20, Washington 1-8700
DETROIT 39, Kenwood 1-1785 • HOUSTON 4, Jackson 6840
LOS ANGELES 14, Mutual 1105 • SEATTLE 7, Hemlock 1351
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HAVEG CORPORATION
NEWARK 10, DELAWARE
TRADE MARK REG. U. S. PAT. OFF.
FACTORY: WILMINGTON 8, DEL. • Wilmington 3-8884
A SUBSIDIARY OF CONTINENTAL-DIAMOND FIBRE CO.

CRUCIBLE FINE STAINLESS WIRE...

now available — all sizes... all tempers

Users of fine wire can now obtain prompt delivery of Crucible stainless steel wire . . . in all diameters . . . in all tempers from full hard to dead soft. And Crucible's fine wire comes in all standard grades — with a bright surface or a variety of metallic and nonmetallic finishes tailored to meet your specific application.

Our new fine wire mill is equipped with the latest facilities for annealing, pickling, drawing and finishing. Our mill metallurgical control setup is the latest word, too, to assure you that every spool and coil produced conforms to Crucible's high standard of quality — dimensional, physical and surface uniformity that is unsurpassed in the industry.

No matter what type of wire you use — whether it be cold heading wire, weaving wire, spring wire, needle wire, screen wire, cable wire, or a host of other types — our new mill is equipped to serve you. For prompt delivery of quality stainless wire, call your nearest Crucible warehouse.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking

STAINLESS STEEL WIRE

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

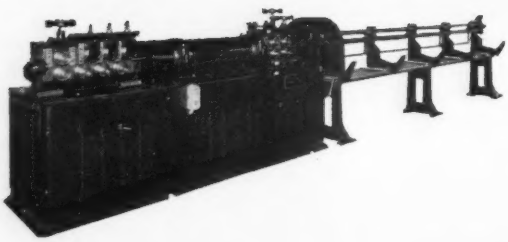
REX HIGH SPEED • TOOL • REZISTAL STAINLESS • MAX-EL • ALLOY • SPECIAL PURPOSE STEELS

NOW - DUAL CONTROL!

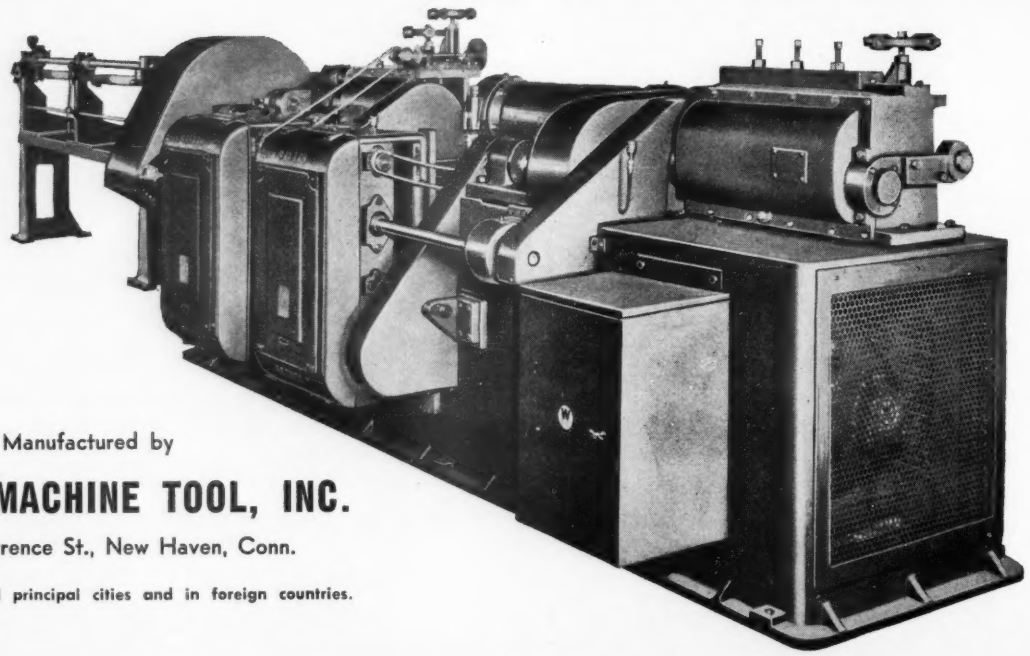
Both the speed of feed, and the speed of cut off are individually controlled by separate variable speed units on each of these new SHUSTER automatic wire straighteners and cut off machines.

SHUSTER *Since 1866*

3 AV & 4 AV *Automatic*
WIRE STRAIGHTENERS & CUT OFF MACHINES
with INFINITE SPEEDS



No. 3AV handles wire ½" dia. max.; 4AV will take 11/16" max. Of all SHUSTER machines built since 1866, we feel these are the best yet. Write for Bulletin 37V and get the complete story.



Manufactured by

METTLER MACHINE TOOL, INC.

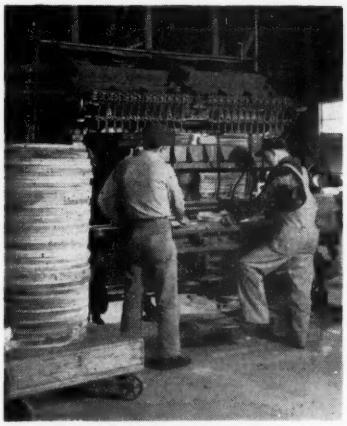
132 W. Lawrence St., New Haven, Conn.

Representatives in all principal cities and in foreign countries.

SHUSTER *Automatic* — *Since 1866* — WIRE STRAIGHTENING AND CUTTING MACHINES

REELS
for
SHIPPING · HANDLING · PROCESSING

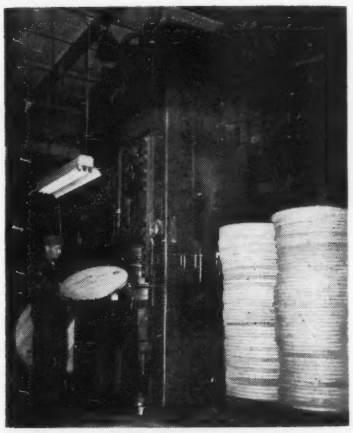
FOR ALL TYPES OF WIRE AND CABLE



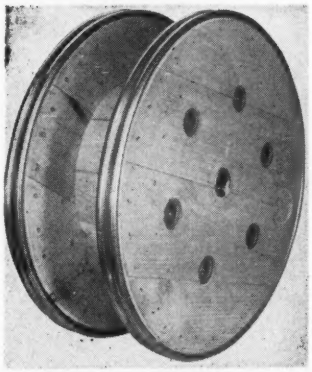
Nailing Operation

NAILED FLANGES—ALL SIZES. Flanges only or assembled as complete reel with stave or steel hub. Produced in our own completely equipped plant.

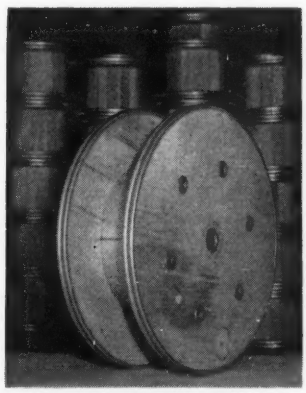
HUBBARD'S DIE FORMED STEEL TIRE. Adds life to reels, eliminates maintenance costs. Applied to nailed, dimension lumber or plywood flanges. Flanges only or assembled with stave, steel or aluminum hubs.



Banding Operation

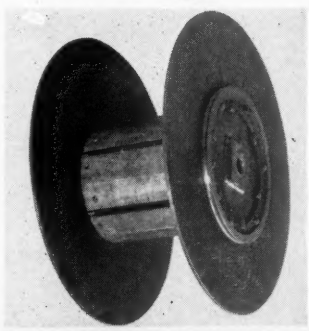


Nailed Reel. Banded for Returnable Types.



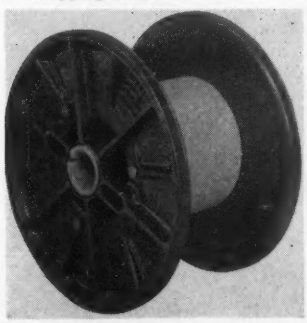
Dimension Lumber for Returnable Reels.

Plywood—Process and Returnable Shipping Reels.



Left: Special Reels Made to Your Designs

The HUBBARD line includes all types of spools and reels required for any shipping, shop or processing need.



Right: Light Alloy Cast Reels for Process & Shipping

HUBBARD SPOOL COMPANY

GARRETT • INDIANA

Telephone: 840

"THE BIGGEST NAME IN SPOOLS AND REELS"

Story of a man who spent all night in the kitchen

(or why use ELGIN Diamond)

Henry was on cloud seven the night of the party. For weeks he'd planned and prepared, checked and double checked. Nothing would go wrong . . . not with old Henry at the helm. And sheer genius, Henry, inviting the boss. Now you're sure to get the raise . . . maybe even a promotion. When the first guests began to arrive, it started . . . Henry mixing drinks, that is. Henry mixed and served — served and mixed and then mixed some more. Afterwards — everyone said they had a perfectly marvelous time, but, wasn't it too bad that poor Henry had to spend so much time mixing things. Ah, yes — poor Henry spent all night in the kitchen . . . mixing . . . missed his own party.

Henry has another party coming up real soon and things are going to be different. You see, Henry's boss told him about ready-mixed drinks. They're much more convenient, save you time and cost less, too. The boss also explained that now-a-days lots of things are ready-mixed. Take for example, the Elgin Diamond they used at the plant for polishing.

"Right", said Henry — grabbing the ball and running with it. "With Elgin Diamond, there's no troublesome mixing or special grading, no expensive waste or chance for error. And our polishing results are consistent, too, because Elgin diamond particles are permanently suspended in a specially formulated, color-identified vehicle. "Bully, Henry, bully", cried the boss.

If your company doesn't now use Elgin Diamond, why not slip your boss the word? Good things always seem to happen when you use Elgin Diamond.

ABRASIVES **DIVISION**

Dept. G

ELGIN NATIONAL WATCH COMPANY

ELGIN, ILLINOIS

ANOTHER IMPORTANT MEMBER OF WATERBURY-FARREL'S LINE OF WIRE-WORKING MACHINERY

HOW THIS WATERBURY-FARREL WINDER puts trolley wire in its place

This new Waterbury-Farrel Trolley Wire Winder has an automatic, hydraulic, spool-traversing feature that assures a very accurate lay of wire.

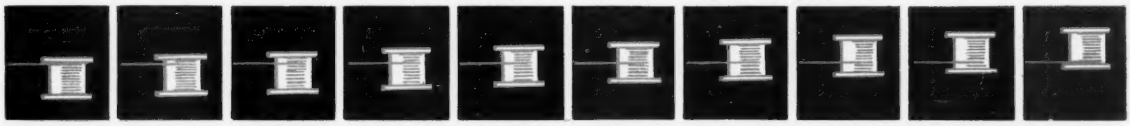
The wire moves straight ahead while the spool itself traverses. It moves across the path of the wire at exactly the right pace to put the wire precisely where it belongs on the spool. A special slip friction device compensates for the build-up of the spool.

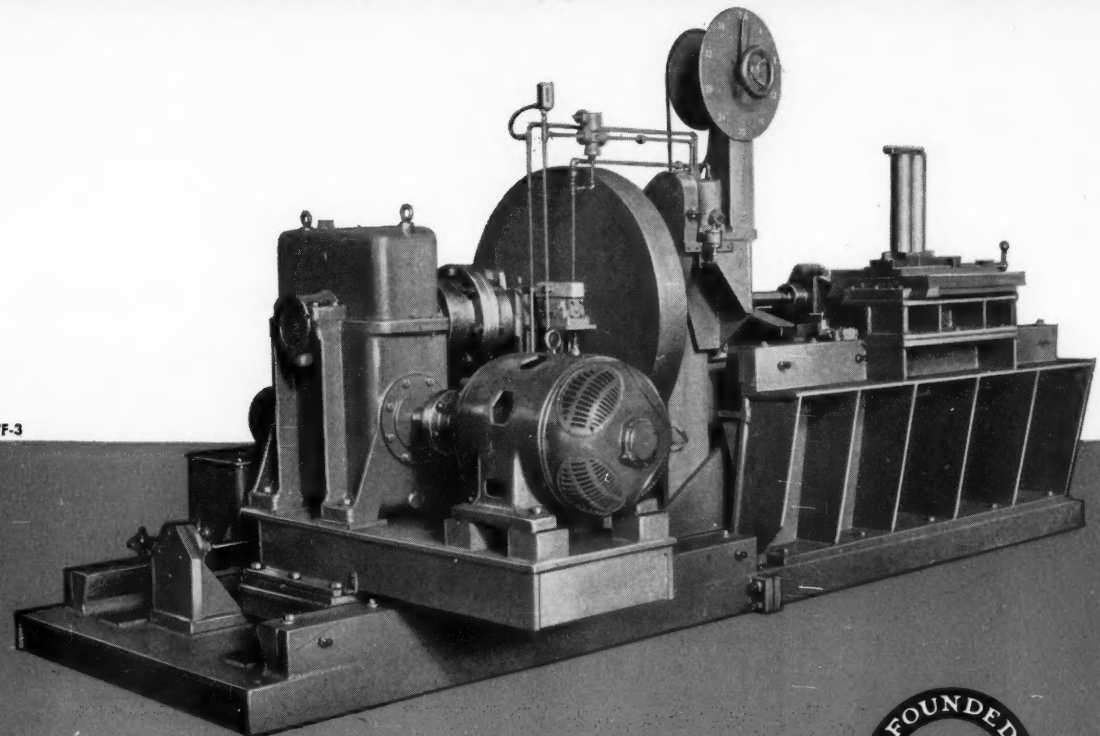
This machine can be furnished to take spools up to 56" O.D., 31" barrel with a 26" traverse. It has a maximum capacity of 7,500 lbs. of wire plus approximately 1,800 lbs. for the spool . . . a total load of 9,300 lbs.

Further information on this machine or on any of the equipment indicated below is available on request.

WATERBURY FARREL FOUNDRY & MACHINE COMPANY
WATERBURY, CONNECTICUT, U. S. A.
Sales Offices: Chicago, Cleveland and Millburn, N. J.

The spool traverses . . . the wire stays straight





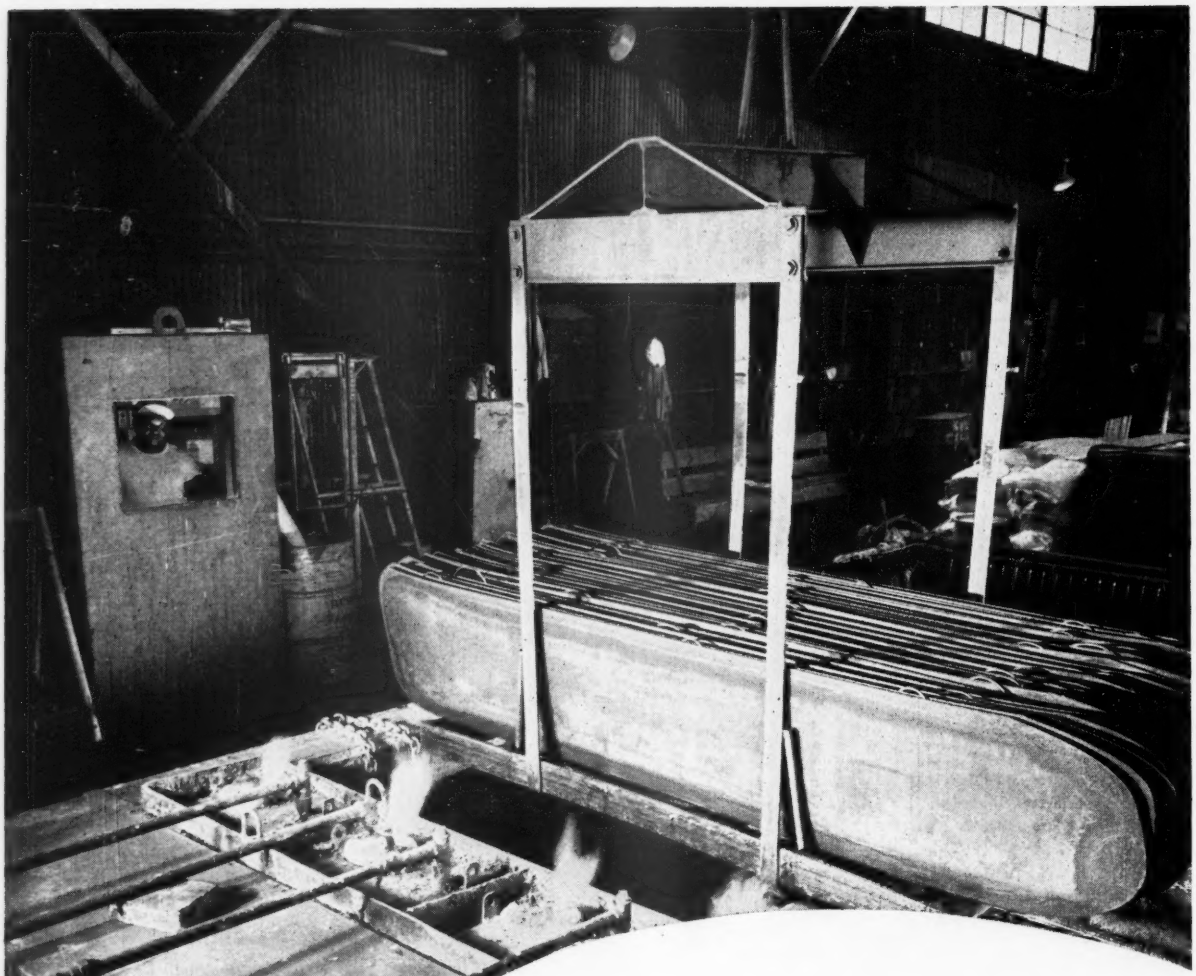
WF-3

A FEW OF THE MANY TYPES OF METAL WORKING MACHINERY MADE BY WATERBURY FARREL

WIRE MILL EQUIPMENT—Continuous Fine Wire Drawing Machines • including Upright Cone and Tandem types • Bull Blocks • String-up Machines • Spoolers, Etc. • *COLD PROCESS BOLT AND NUT MACHINERY*—Headers (all types) • Re-headers • Trimmers • Thread Rolling Machines • Slotters • Nut Tappers, etc. • *POWER PRESSES*—Crank • Cam and Toggle; also Rack and Pinion Presses • Transfer Presses • Multiple Plunger Presses • Hydraulic Presses, etc. • *MILL MACHINERY*—Rolling Mills • Wire Flattening Mills • Chain Draw Benches • also Slitters • Straighteners • Pointers Swagers • Cut-off Saws • Coilers • Winders, etc.

FOUNDED WATERBURY FARREL 1851

In Equipment, Experience Counts . . .



Safely descale most metals in 20 minutes or less!

WITH THE DU PONT SODIUM HYDRIDE PROCESS

You can thoroughly descale any metal unaffected by fused caustic at 700°F.—in any size or shape—within 20 minutes in a sodium hydride bath. And because bath action stops the instant scale is reduced, there's no loss of valuable base metal—no pitting or etching to cause costly rejects.

Du Pont—pioneer of sodium hydride descaling—will be glad to give you all the details about its economical, easy-to-operate process. Just write or phone Du Pont's nearest district office or mail the coupon below.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING... *THROUGH CHEMISTRY*

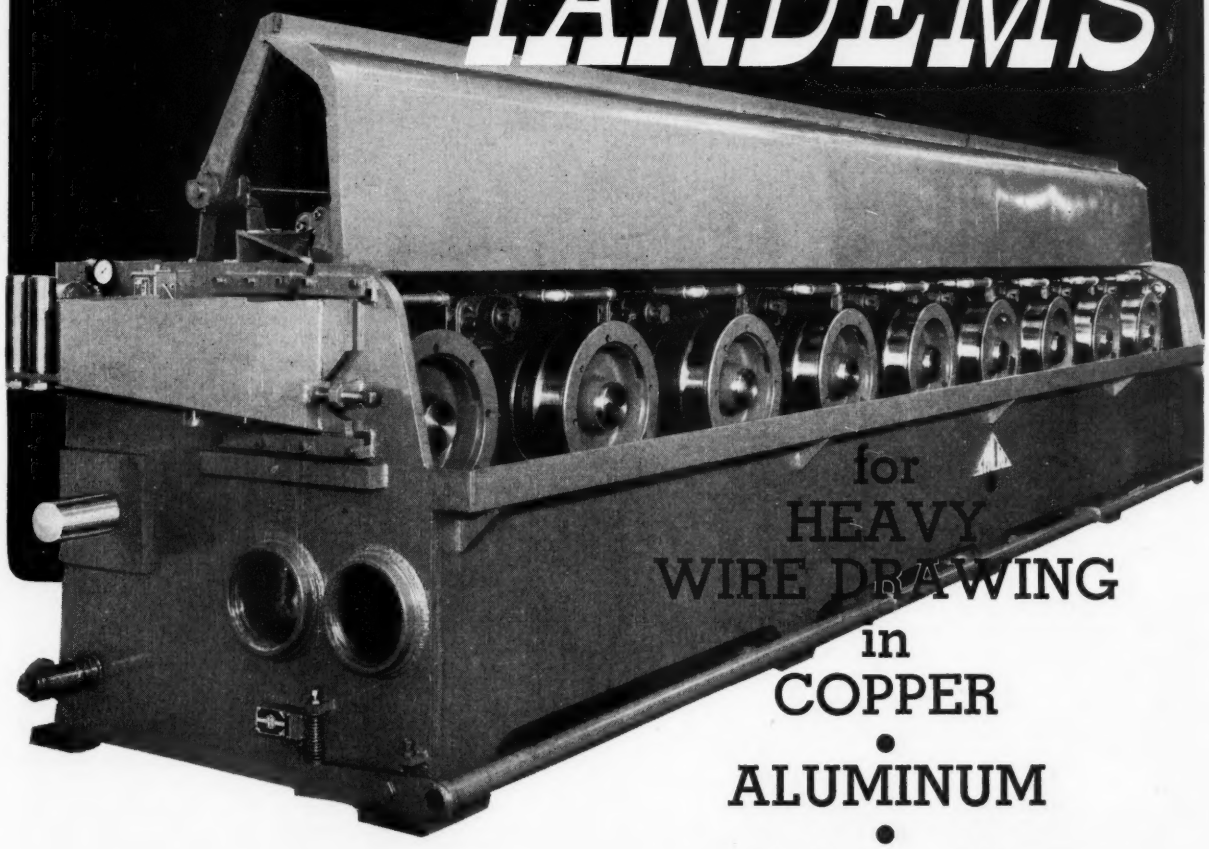
E. I. du Pont d eNemours & Co. (Inc.)
Electrochemicals Department, WW11
Wilmington 98, Delaware

☐ Send me your descriptive booklet on Sodium Hydride Descaling.
☐ Have a Du Pont man call. I am descaling _____

Name _____
Position _____
Firm _____
Address _____
City _____
State _____

a complete line of...

TANDEMS



for
HEAVY
WIRE DRAWING
in
COPPER
•
ALUMINUM
•
and their alloys

- HIGH Speed!
- MINIMUM Slip!
- SPOOLS and COILS!
- HARD faced BLOCKS!
- AUTOMATIC Lubrication!
- LOW Maintenance!
- ADJUSTABLE dieholders!
- HEAVY construction!

SYNCRO Tandem design provides a basic machine employing highly efficient component BLOCK drive assemblies. Inbuilt characteristics of this line allow the utmost in drawing versatility.

WRITE for complete information

SYNCRO MACHINE COMPANY
PERTH AMBOY • NEW JERSEY • USA

SYNCRO®

Better Machinery for the Wire Industry

AFFILIATED COMPANY, WINGET-SYNCRO, LTD. ROCHESTER, KENT, ENGLAND

Fastest Process Annealing FOR COILED STEEL WIRE

- ✓ Annealing cycles accomplished in minutes rather than in hours
- ✓ 50% lower equipment cost
- ✓ less floor space
- ✓ no scale, decarburization, or other atmosphere effects

On-the-job production figures prove that no other method compares with an Ajax Electric Salt Bath Furnace in speed, uniformity, cost saving, and general all-around efficiency in process annealing all types of steel wire as well as aluminum, copper alloys, and silver alloys.

Heating cycles are far faster. Absolute uniformity is assured. Thanks to the exclusive Ajax electrodynamic stirring action, the temperature does not vary more than ±5°F. *in any part of the bath.*

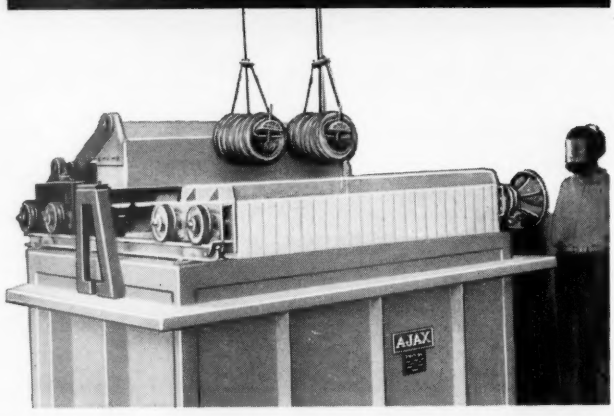
The Ajax Salt Bath eliminates all atmosphere with its accompanying problems of oxidation, pitting, and decarburization. Preservation of metal surface is assured. Equipment cost is much lower —and the Ajax handles more work for a given amount of floor space than any other method. Ajax Reprints 62 and 63 gladly sent on request.

LOW- AND HIGH-CARBON STEELS

This typical Ajax installation process anneals 1200 lb. 18-gauge wire an hour in only 58 feet of floor space.

STAINLESS STEEL

Annealing fine gauge nickel-chromium wire at 1950°F. Clean wire surface eliminates conventional pickling operations.



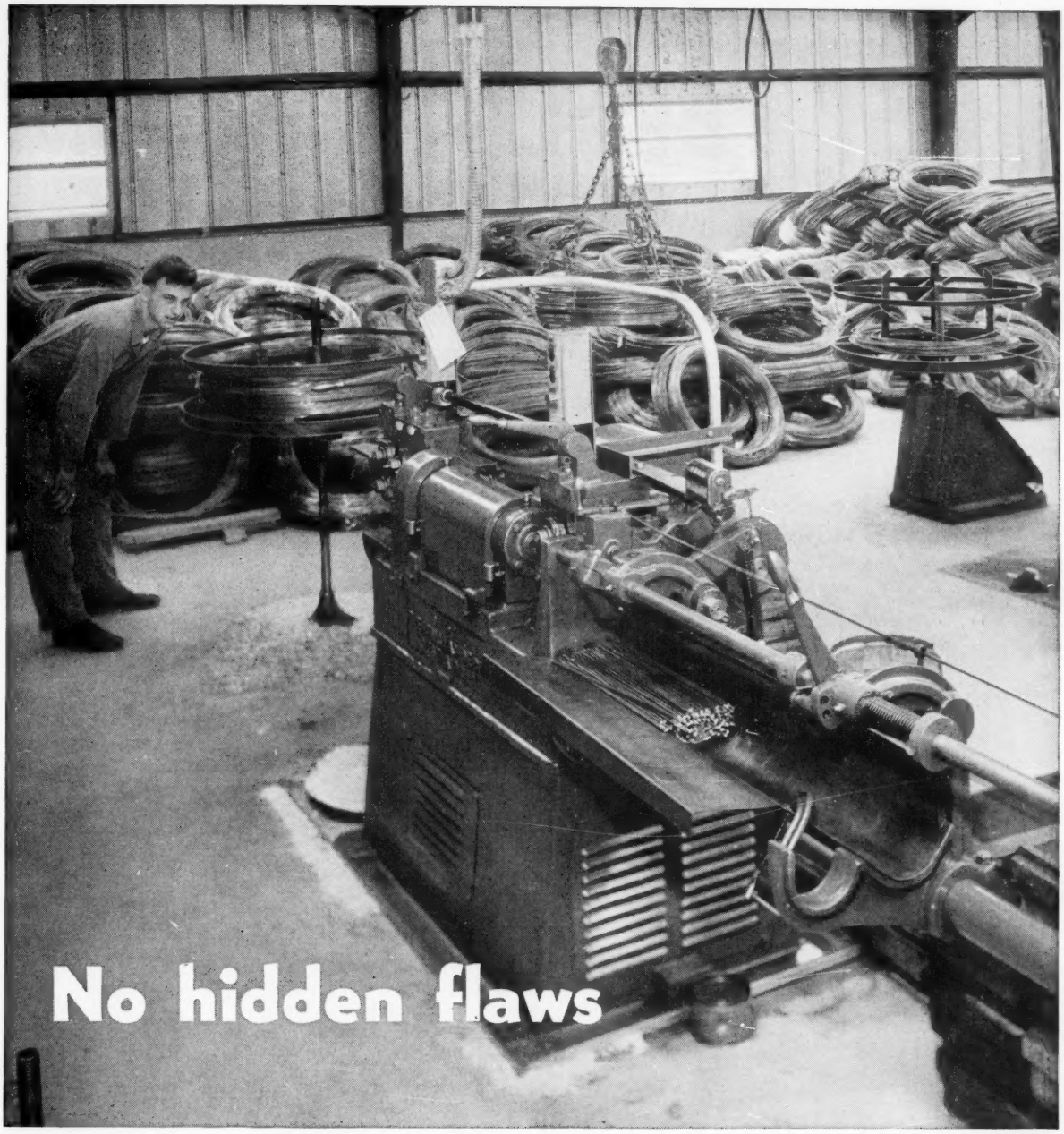
- **TOPS for WIRE PATENTING, too!**
- **IDEAL FOR DESCALING** hot-rolled stainless and alloy steel wire and other shapes employing either the Dupont sodium hydride or the Hooker Electrochemical Virgo bath.

Associate companies: Ajax Electric Furnace Corp. • Ajax Engineering Corp. • Ajax Electrothermic Corp.

AJAX electric SALT BATH furnaces

OVER 4,000 INSTALLATIONS . . . more than all other salt baths combined

AJAX ELECTRIC CO., Inc., 928 Frankford Ave., Philadelphia 23, Pa.



Youngstown

QUALITY YOUNGSTOWN SERVICE

BRIGHT BASIC WIRE

●No matter how much your machines may bend or crimp or bite Youngstown Wire, its superior qualities pay off in better wire products. Reasons: Youngstown Wire is uniform in diameter—has no injurious imperfections—is rigidly inspected to insure the exact ductility and other qualities you want. Call our nearest District Sales Office for prices and delivery dates.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

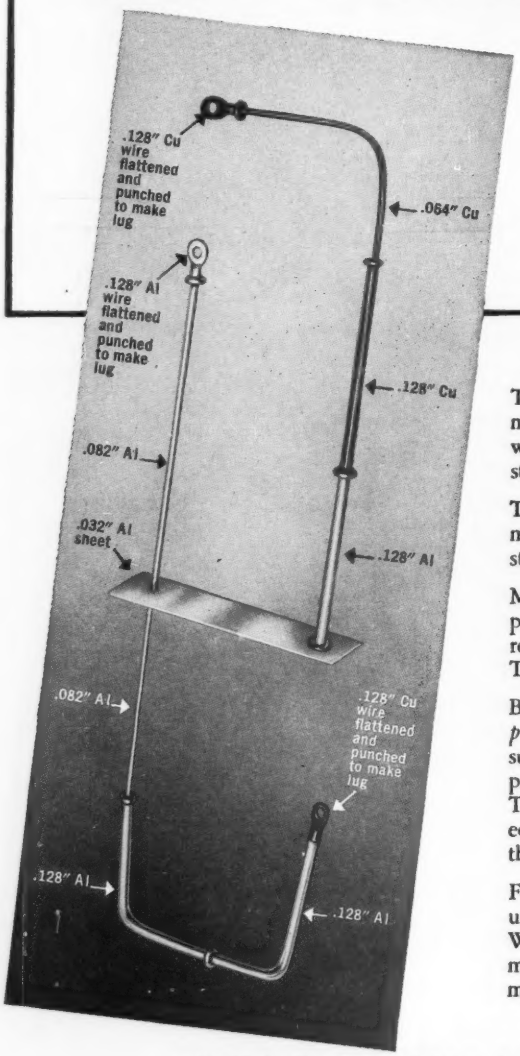
General Offices: Youngstown, Ohio - District Sales Offices in Principal Cities

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES

GET PERFECT WELDS

without heat, electricity or chemicals

in just seconds!


.128" Cu wire flattened and punched to make lug
.064" Cu
.128" Al wire flattened and punched to make lug
.128" Cu
.082" Al
.032" Al sheet
.128" Al
.082" Al
.128" Cu wire flattened and punched to make lug
.128" Al
.128" Al

This new and perfected process buttwelds through pressure *alone*—the metal is pressed together between specially designed dies. UTICA Koldwelding is so easy and foolproof that even unskilled workers of average strength can make perfect welds in just seconds.

They're real *welds*, too—not just bonds! Actual inter-molecular flow of metal occurs. Tests show Koldwelds have 95% to over 100% the tensile strength of the parent wire.

More than that, the inter-molecular connection results in an electrically perfect splice. No flux, second metal or alloy is present at weld. Electrical resistance will not change because of oxide films, corrosion, moisture, etc. There is no change in wire diameter—and flash is easy to remove.

Buttwelding is done with a hand tool 14" long, *weighing only five pounds!* Each UTICA KOLDWELDING tool is supplied with lightweight carrying case and precision dies to fit the user's specific needs. This UTICA tool with its dies is the total equipment needed for Koldwelding out in the field or in the production line!

For further information, please write telling us as much as possible about your application. We should know the sizes and grades of metals to be welded and other pertinent information.

WELDS UNLIKE METALS!

Many difficult wire welding jobs can be accomplished easily with UTICA Koldwelding equipment. The process buttwelds various *non-ferrous* metals such as aluminum, hard and soft electrical copper, platinum, silver and other metals—welding the same or unlike metals together . . . such as aluminum to copper, etc. Also easily welds different gauges of wire together. Flash is easily removed with fingers or small pliers. Wire may be drawn after Koldwelding and tests show it will part at some point remote from the Koldweld. Typical wire mill tests have drawn Koldwelded .164 aluminum wire down to .019 at high speed—with fifteen Koldwelds in a 25-foot length. There were no breaks, no identification of Koldwelded joints after drawing.

Made by UTICA*—producers of 86 types of pliers, most in several sizes . . . and other fine forged tools.*

UTICA KOLDWELD

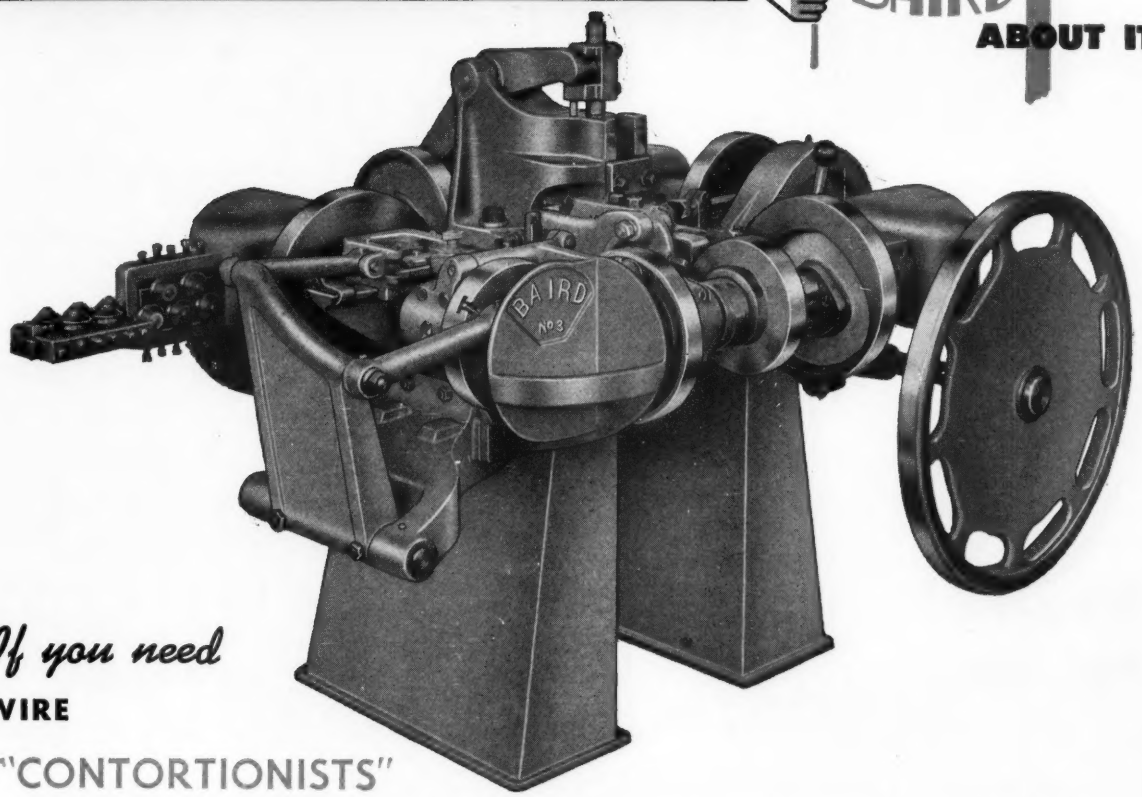
U TI CA®

DROP FORGE & TOOL CORP., Utica 4, N. Y.

"UTICA", when applying to tools made by Utica Drop Forge & Tool Corp. is a Trade Mark Reg. U. S. Pat. Off.

. . . IF IT'S A HIGH PRODUCTION PROBLEM . . .

ASK BAIRD ABOUT IT



If you need

WIRE

"CONTORTIONISTS"

The BAIRD FOUR-SLIDE is your FORMING MACHINE

There is probably no machine in the world that can make a greater variety of parts . . . or produce them any faster . . . than the Baird Four-Slide. It seems that there must be a limit to the fashioning of small wire and metal ribbon products *by hand* . . . and then tooling a Baird Machine to make them *automatically.* Yet, new shapes are continuously submitted to us . . . and we still find the solutions.

Taking coiled wire from a reel, the machine straightens, feeds, and cuts off the required length . . . then forms and ejects the part. Different sizes of standard machines give you a selection of wire lengths to 32½" . . . dia. to ½" or flat ribbon metal products to 1½" wide. Special attachments such as *secondary cut-offs, lettering, form raising, pin pulling, nail pointing, vertical forming and stripping, ring setting, etc.,* extend the versatility of operations.

Thus you may purchase your machines for specific repetitive production, then, at any time, add special attachments as your production requirements indicate. At all times you may count on Baird engineers for development of tooling from your parts or specifications.

This is your profit-making machine. Send for the Baird Four-Slide Bulletin.

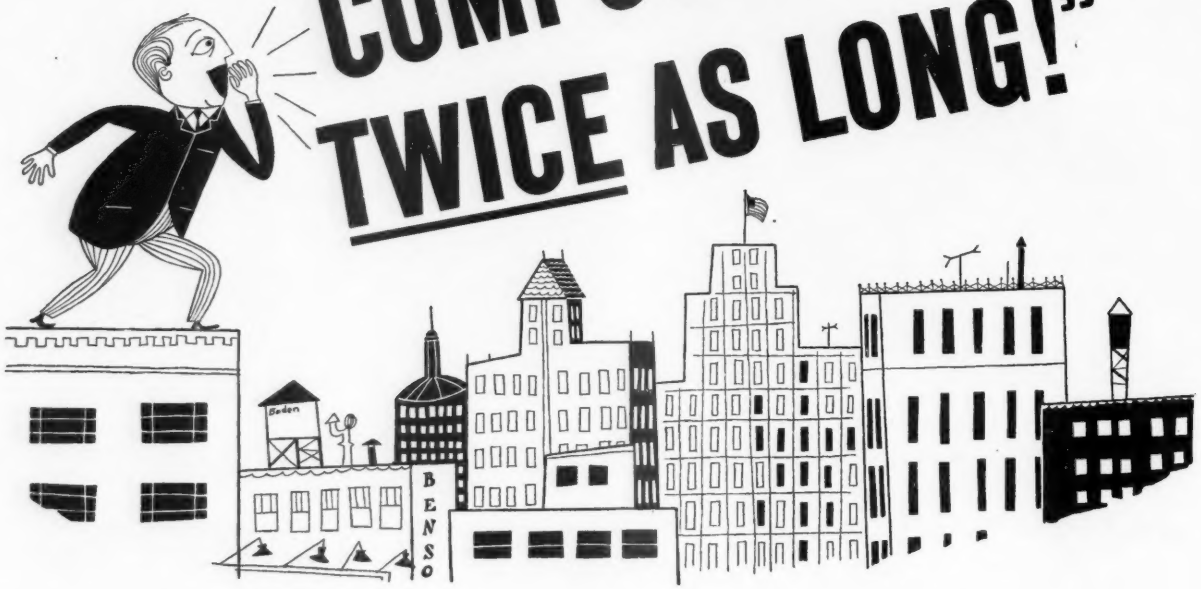
2BA54

THE BAIRD MACHINE COMPANY
STRATFORD CONNECTICUT

WHERE YOU WILL GET THE HELP OF SPECIALISTS ON THESE ESSENTIAL PRODUCTION PROBLEMS:

AUTOMATIC MACHINE TOOLS • AUTOMATIC WIRE & RIBBON METAL FORMING MACHINES • AUTOMATIC PRESSES • TUMBLING BARRELS

"DURPON® DRAWING COMPOUNDS LAST TWICE AS LONG!"



...and cost no more!

You're right—we do tell the same story again and again about Nopco DURPONS. But once you've tried these famous lubricants in your wet drawing of non-ferrous metals, you'll agree it's a story worth repeating. The reasons for this long life are two: a buffer which prevents the breakdown of the emulsion, and a sequestering agent which keeps the bath clean. Why not wire or write today for a 5-gallon testing sample?

"Stay Stable Longer"

DURPON
for intermediate wire

DURPON L
for rods, tubes, heavy wire

DURPON FW
for fine wire

NOPCO CHEMICAL COMPANY

NOPCO TRADEMARK EVOLVED THRU RESEARCH

Harrison, New Jersey

Cedartown, Ga. • Richmond, Calif.

MODEL 126
Patents Applied For

NOW - an **attachment** for continuous wire packaging

For the first time you can *adapt your existing machinery* to continuously package wire in fibre containers . . . 600 pounds in each! And it can be done without a large capital expenditure in new equipment. With Coulter & McKenzie Attachments your own machines will *continuously* pour wire into PAYOFFPAKS . . . ready for delivery!

These features make it easy to cash in on the PAYOFFPAK:

SYNCHRONOUS OPERATION through positive Overarm Drive from any vertical or horizontal block.

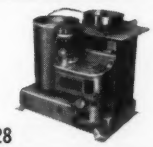
COMPACT DESIGN allowing the Attachment to be located in any one of many positions around your machinery.

CONVENIENT OVERARM disconnects and swings aside for selective return to conventional coil and spool operation.

The Coulter & McKenzie Model 126 Attachments will be built to your specifications.

Write today for the Coulter & McKenzie "Attachment Questionnaire."

MODEL 116



MODEL 128

Other PAYOFFPAK machines are available for continuously drawing (Series 116) or packaging (Series 128) fine or coarse wire. Write today for complete information . . . Kindly state your requirements.

A FULL RANGE OF WIRE FROM SOFT COPPER TO HIGH CARBON, AND FROM .012" TO .250" IS BEING PAYOFFPAKAGED.

Continental Can Company Licensee

771 WATER STREET
OPPOSITE RAILROAD STATION

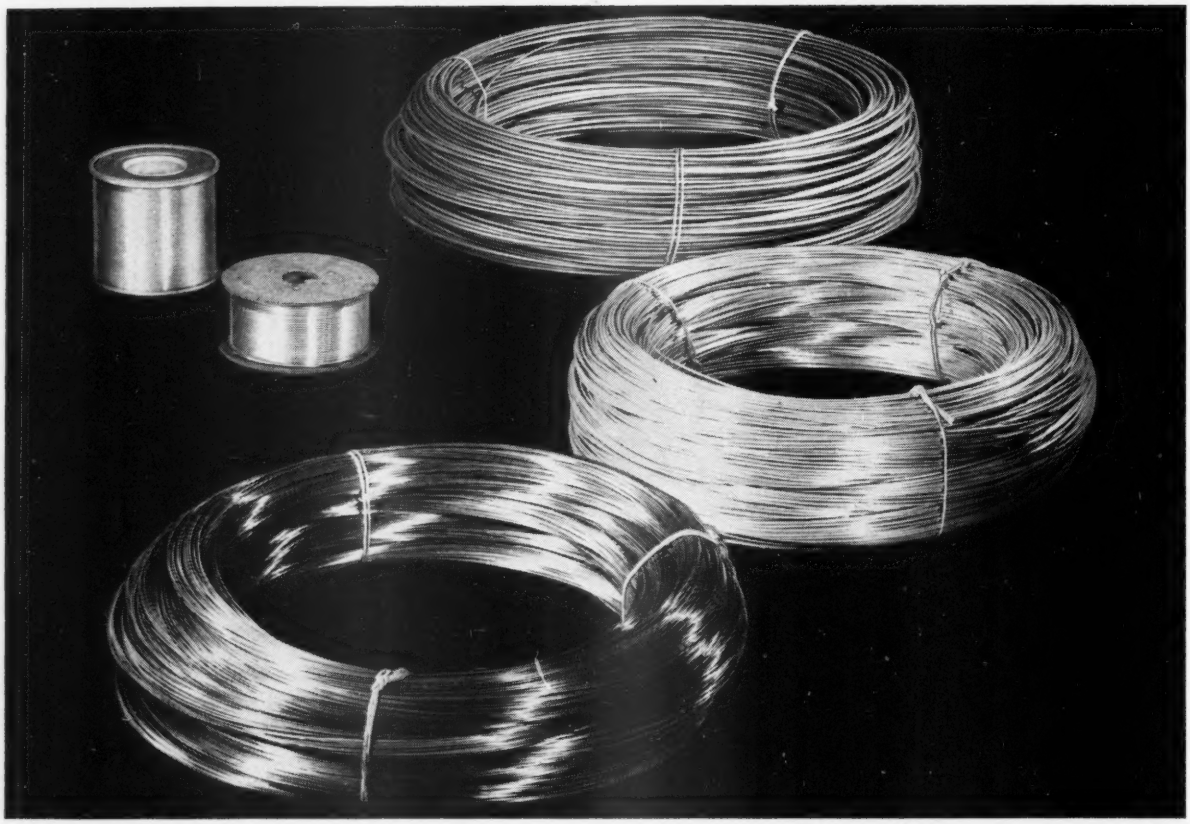
TELEPHONE EDISON 5-1101
LIEBER'S CODE "MACKENZIE"

THE COULTER & McKENZIE MACHINE CO., INC.

SINCE 1843

BRIDGEPORT 3, CONNECTICUT, U. S. A.

INCORPORATED 1881



Wire products to meet your specifications

FROM ONE OF THE NATION'S MOST MODERN MILLS!

To SUPPLY YOU and hundreds of other fabricators with a broad line of highest quality wire products, Kaiser Aluminum operates one of the best-equipped high production mills in the nation.

Our wire products include round drawn wire, hexagonal wire, rivet wire, welding wire, spooled fine wire, screen wire, and EC wire—in alloys, diameters and tempers to meet your exact specifications.

In addition, we produce redraw rod and redraw wire for further drawing by wire mills into finished products.

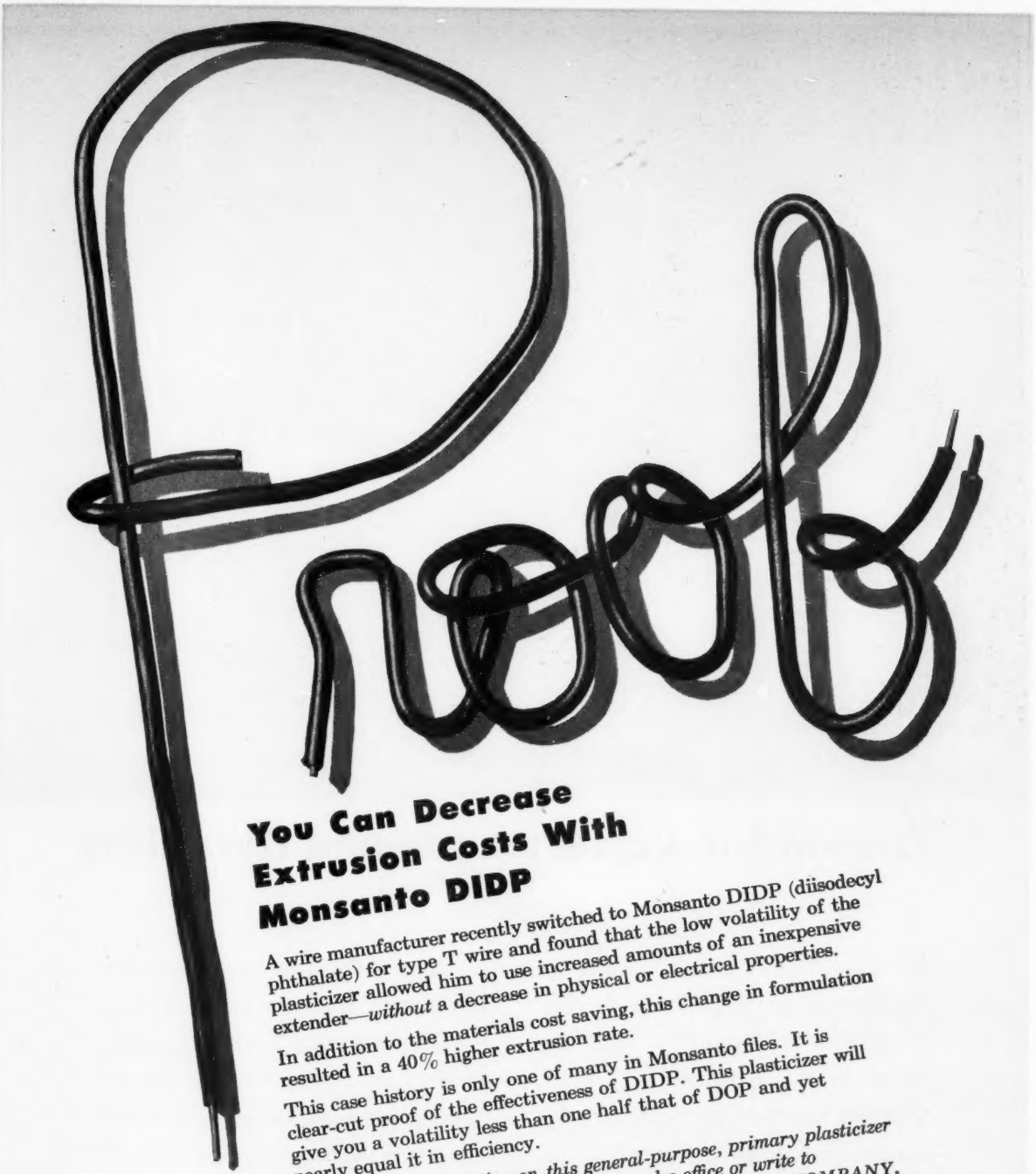
We believe we are ideally equipped to work with you, because serving manufacturers with basic aluminum is our primary business.

You get prompt service and dependable delivery from our centrally-located plant in Newark, Ohio. In addition, we have vastly expanded our national warehousing system, our distributor program and our staff of metallurgists and field engineers.

For immediate attention to your needs, contact any Kaiser Aluminum sales office listed in your telephone directory or one of our many distributors. Kaiser Aluminum & Chemical Sales, Inc. *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Oakland 12, California.

Kaiser Aluminum

setting the pace—in growth, quality and service



You Can Decrease Extrusion Costs With Monsanto DIDP

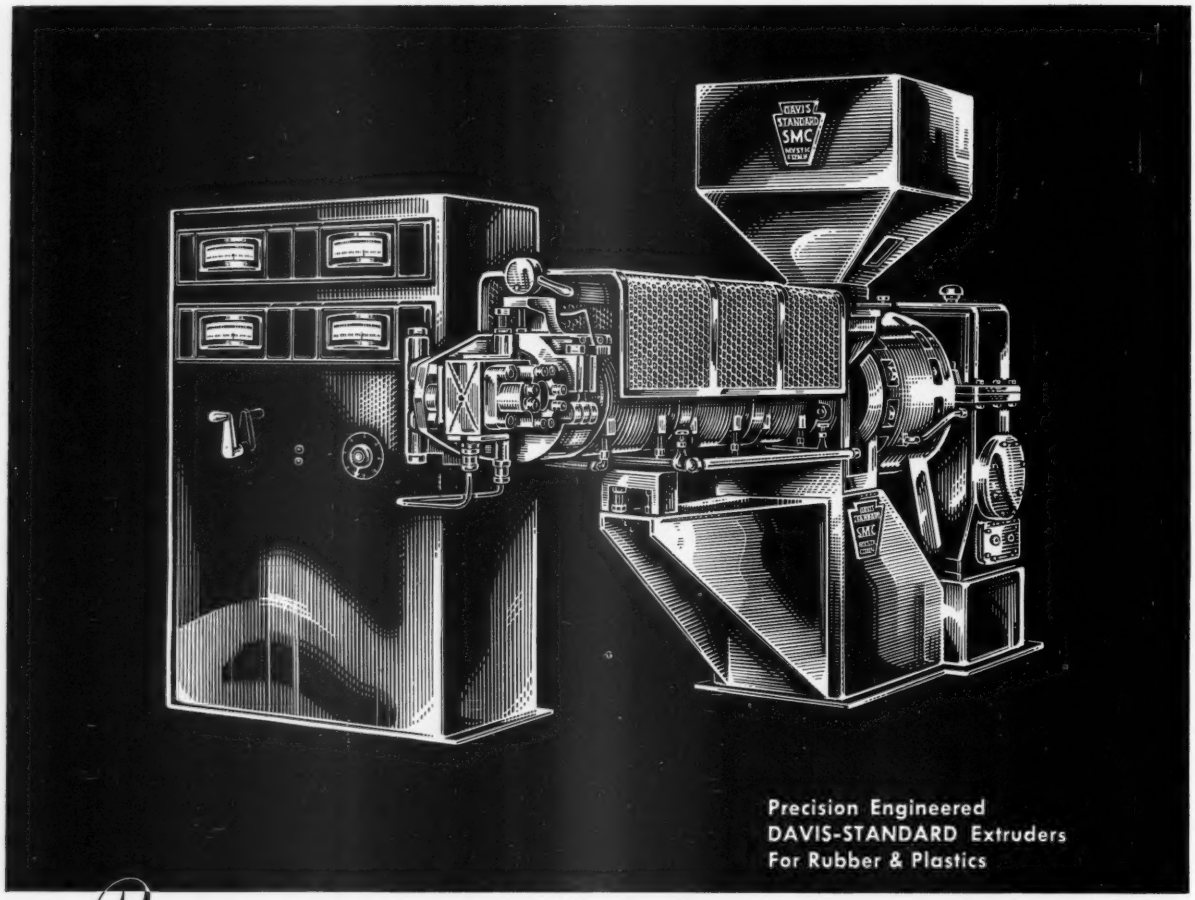
A wire manufacturer recently switched to Monsanto DIDP (diisodecyl phthalate) for type T wire and found that the low volatility of the plasticizer allowed him to use increased amounts of an inexpensive extender—*without* a decrease in physical or electrical properties.

In addition to the materials cost saving, this change in formulation resulted in a 40% higher extrusion rate.

This case history is only one of many in Monsanto files. It is clear-cut proof of the effectiveness of DIDP. This plasticizer will give you a volatility less than one half that of DOP and yet nearly equal it in efficiency.

For complete information on this general-purpose, primary plasticizer for polyvinyl chloride, call your nearest sales office or write to Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, P. O. Box 478, St. Louis 1, Missouri.

MONSANTO
CHEMICALS AND PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND



Unmatched Performance and Durability

IN every field of endeavor, there invariably emerges a champion, an elite, to serve as a standard by which the efforts of the rest may be judged. Whether in a man or a machine, the aura of quality, mark of the aristocrat, is unmistakable.

For those who want their own products to excel, for those who seek the finest extruding machine available, for those who understand the ultimate economy in buying the best, the answer is Davis-Standard, symbol of character and achievement.

DS

DAVIS-STANDARD SALES CORPORATION

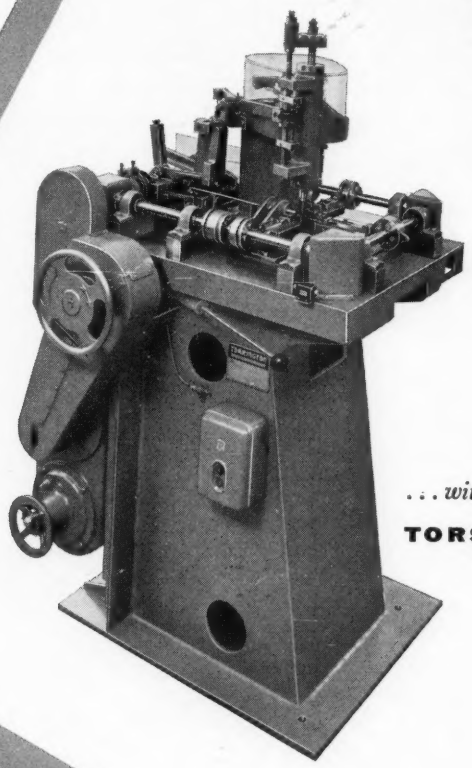
20 Water Street Mystic, Connecticut

Sole selling agents for

THE STANDARD MACHINERY COMPANY

World's Largest Manufacturers of Custom-Built Extruding Machines

There's room for greater profits



. . . with the NEW Torrington W3001

TORSION SPRING WINDER

Room — room in which to work — is the outstanding feature of Torrington's new torsion spring winder. This modern, high production machine actually provides the largest tooling area ever devised. In addition, the W3001 offers many other advantages which will help spring-makers boost their production of torsion springs and reduce their costs at the same time.

• Tooling area measures 12" by 18" • Tooling is faster and easier • Tools themselves can be made sturdier and more durable • Shafts on 3 sides plus vertical 2-slide attachment give great versatility in producing complex forms • Capacity extends to 10 turns of .080" wire, thus meeting the great majority of customer requirements for torsion springs • Rugged design means years of trouble-free operation with minimum downtime for maintenance and repairs.

The Torrington Manufacturing Company has built more spring coiling machinery since 1937 than all other manufacturers combined. The knowledge and skill gained while serving spring makers during this period has now been used to create a torsion winder which we firmly believe is the finest ever offered to the industry. If you manufacture torsion springs, this new machine will give you faster, more efficient production and unprecedented versatility to meet your customers' most exacting needs.

Call or write, *now*, for full information.

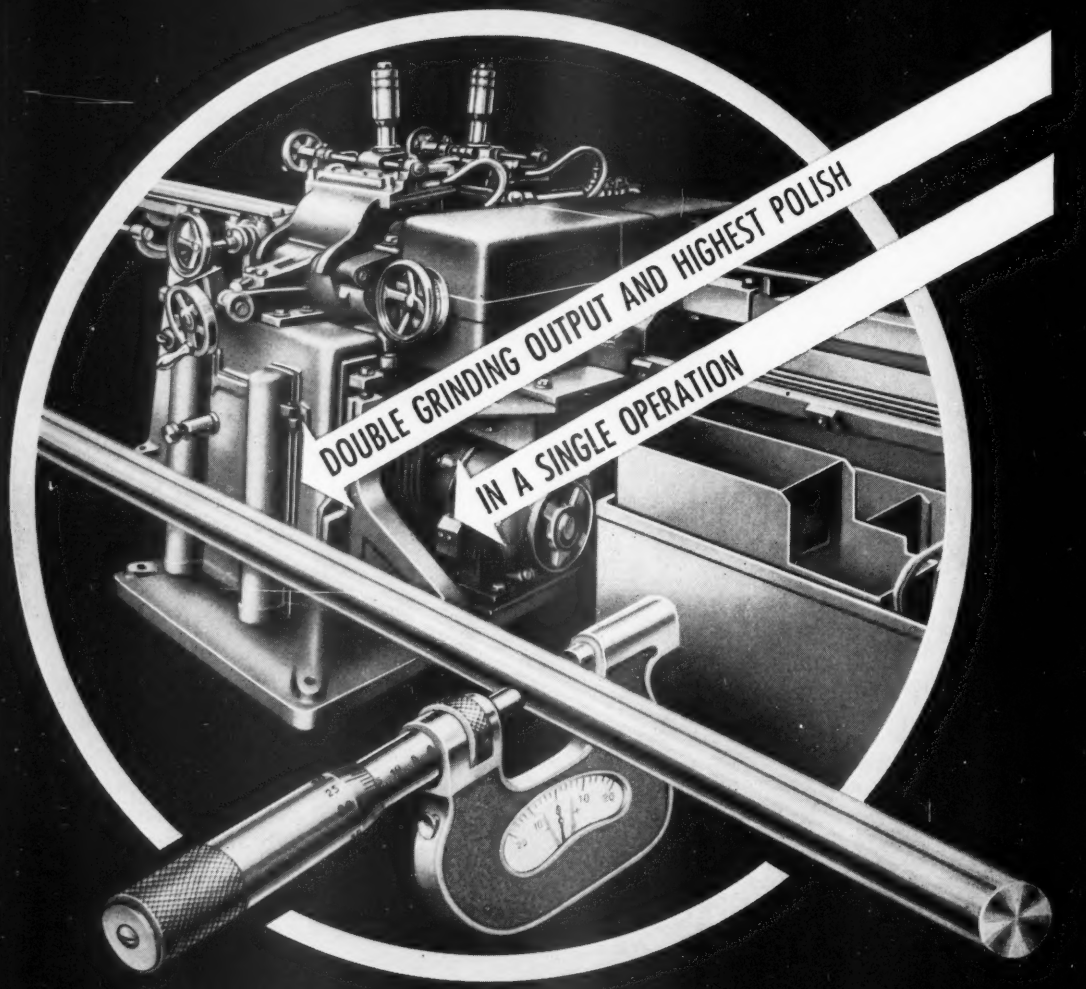
See the Torrington exhibit at the National Metals Exposition, November 1 to 5. Booth 2060, International Amphitheatre, Chicago.

THE
TORRINGTON
MANUFACTURING COMPANY
TORRINGTON · CONNECTICUT
WIRE FORMING MACHINERY DIVISION

SCHUMAG AACHEN

GRAPHIK JUPP KUCKARTZ

CENTERLESS BAR GRINDING AND POLISHING MACHINE



EXCLUSIVE REPRESENTATIVES FOR USA, CANADA & MEXICO
American Laubscher Corp.,
Fisk Bldg., 250 West 57th Street, New York 19, N.Y.

"America's Finest Wire Drawing Lubricants"

THE INDISPENSABLE INGREDIENT

WHAT AM I?

I attract buyers.

I build sales.

I provide for job security.

I cost nothing. Yet I should be a part of everyone's handiwork.

I am an integral part of fine craftsmanship.

EVERYBODY WANTS ME

I am your responsibility.

I create friendship and good will.

I inspire respect and confidence.

I assure acceptance of your work.

I am often not seen. But I am a most important ingredient.

I AM "QUALITY"!

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

Standard Industrial

COMPOUNDS CO., INC.

4600 WEST FERDINAND STREET

CHICAGO 44, ILLINOIS

TELEPHONES: Mansfield 6-9324-5-6

HERBORN

1. Non-Slip Multi-Hole Drawing Machine, Model G II d, with double draft arrangement to draw patented high carbon Steel Wire. Inlet dia. of wire: up to .2765 in. Finished wire: ranging from .0984 in. to .0630 in.

2. Manufacturers of a complete range of modern wire drawing equipment covering all requirements. Free technical advice is at your disposal.

3. Individual grouping of blocks.

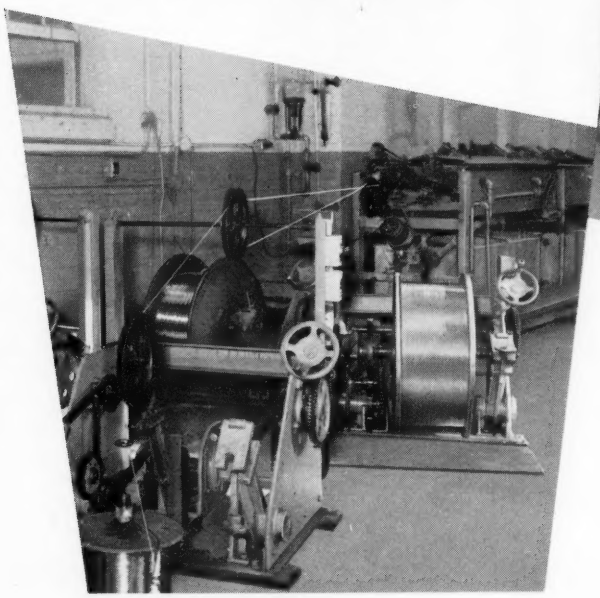
Maschinenfabrik Herborn

Berkenhoff & Drebes A.-G. Herborn (Dillkreis)

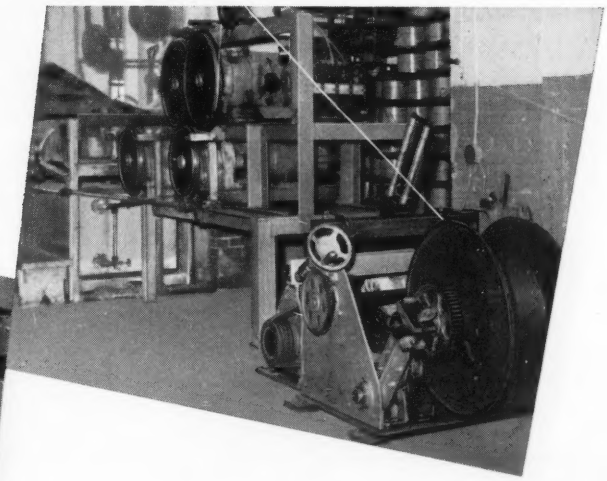
4. Specialty: Machines and equipment for the Wire Drawing Industries.

Continuous Electrotinning

shows Speed and Economy at Federal Wire and Cable



Pay off equipment—wire feeding into cleaning tank prior to entering plating bath.



Take up equipment—wire emerging from plating tank.

An M&T Continuous Electrotinning installation, now in operation at Federal Wire and Cable Company, Ltd., Guelph, Ontario, is providing high speed tinning along with many other advantages.

For example, No. 14 gauge copper wire is being tinned at speeds of up to 800 ft. per min. And, heavily tinned wire of such gauges as .064 in. and .040 in. is being drawn to smaller sizes, including .0064 in., and continuously annealed. The drawn wire meets ASTM specifications for continuity of coating and for elongation.

High speed, continuous electrotinning of copper wire, developed by M&T to replace hot tinning is more economical because it uses less tin—electrodeposited coatings approximâtely one-fifth the thickness of normal hot tinned coatings meet ASTM specifications —there are none of the tin drossing losses which are inherent to hot tinning. Appreciable savings in labor and equipment over older methods of tinning also result. In addition, coating thicknesses are readily controlled and tin is deposited evenly and uniformly on the wire.

It will pay you to investigate continuous electrotinning of copper wire. Write today for more detailed information.

METAL & THERMIT CORPORATION

100 EAST 42nd STREET, NEW YORK 17, N.Y.

For the FINEST Dies...

Specify

There Are Many Reasons Why V-R Leads The Field!

V-R NEW Cylindrical nib and improved method of assembly insure high degree of concentricity.

V-R . . . First in producing the only Tantalum-Tungsten carbide developed specifically for Drawing Dies.

V-R . . . First to manufacture Carbide Dies with preformed rough cored back relief.

V-R . . . First to furnish Carbide Dies rough cored to finish at hole sizes below .010".

WRITE TODAY for NEW Vascoloy-Ramet Die Catalog VR-461.

The New V-R Die Catalog gives complete ordering information on all V-R Dies for drawing wire, rod, bar and tube.

Vascoloy-Ramet CORPORATION

874 MARKET STREET

WAUKEGAN, ILLINOIS

The Wire Outlook

The long anticipated upturn is now assuming substantial proportions. The steel industry's order books, a good index, are now beginning to reflect a turn for the better. In fact, one large Pittsburgh steel and wire concern has returned to capacity production. The improvement embraces carbon, stainless and alloy steels and specialty lines. Bar sales are only slightly up.

Strikes in Chile and this country will affect the copper supply for the balance of the year. Copper is playing an important role in expanding electric generating capacity, electronics, television and various industrial applications and, with the demand on the up-grade, the copper wire and brass mills will probably face a temporary shortage for some months. Demand in Europe has also increased, making the markets there strong. It is expected that more aluminum will have to be used to fill in the gap.

Barbed, twisted and woven wire fencing sales have been good, better this year than last, but still under 1952. The outlook is even better for next year, although there will be the usual seasonal winter slump. Woven wire fencing is the biggest item, with welded fence available, but only small in volume of sales. Business in ornamental lawn and chain link fence, for plant protection, has been good. Competition is keen. While galvanized fencing is still the biggest item, aluminum and stainless steel fences, particularly in areas with corrosive atmospheres, are gaining steadily in popularity.

Merchant wire is falling off seasonally, but manufacturers wire for automotive and appliance use is on the rise. Welded wire fabric output for reinforcement purposes has been at an all-time high, but will decline in the winter. Heavier buying by the auto industry is expected and for next year larger demand for building wire is looked for. An increased tempo in rod buying has been noted.

One of the traditional signs of better business is the demand for ferro-alloys. Historically, these alloys are the first to fall off and the first to pick up. The present cycle indicates that the tradition is following the pattern, as orders for such alloys began to show improvement well ahead of carbon steel sales, pointing to a real upturn for the steel industry.

Population has been growing faster than predicted. From 1940 to 1950 there was a net gain of 19 million, with the gain for 1950 to 1960 now estimated at about 30 million. The slow-up in the birth rate that was expected has not materialized. Highway construction is increasing under the Government's $50 billion program. Plans for new schools, hospitals, office buildings and home construction provide a backlog that will keep industry busy for a long time. All these factors mean good business ahead.

With high private and defense spending levels, we are still in an inflationary period, even though it is considered to be "controlled." We can hence expect that there will be a very general demand for further wage increases next year—some are in process right now—to offset the slowly rising living costs.

Business confidence also is reflected in this year's dividend record. Corporations are paying dividends at rates that average about 5% more than last year according to a Department of Commerce report. While this is not indicative of a boom, it is one more straw in the wind to assure us that a period of good solid business is in store in the months to come.

—from the Editor's Desk

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 29 November, 1954 No. 11

Quality Control in the Wire Industry

by Axel U. Sternlof
Division Product Engineer, Quality Control
Electrical Cable Works
American Steel and Wire Division
United States Steel Corporation
Worcester, Mass.

This paper is a sequel to a similar presentation before the nonferrous section at a regional meeting held in Worcester, Massachusetts in April of this year. In that paper I brought out the fact that Quality Control is a most valuable tool for the more efficient operation of industry through improved quality of product with less scrap and re-process material.

★ ★ ★

In the present paper I wish to bring out certain details on the installation of quality control that may help others who might be faced with a problem similar to ours. This problem is typical of all job-shop quality control installations where we have nothing but short runs with frequent set-ups, etc. Then, too, we have the problem of very close tolerances in the fine wire sizes as well as the more liberal tolerances in the larger wire sizes.

★ ★ ★

We shall concern ourselves with a coated copper wire having a nominal diameter of .1168″ and a ± .0006″ tolerance. Theoretically, trouble has been reported from the Electrical Testing department that the stranded conductors made up from this wire size are running too high in resistance. One reason for this could be low diameter. Quality control goes to work on this wire size to see what the trouble is. The first slide clearly shows what the trouble is. Here we see only the average part of the control chart. The range part of the chart was in control with an average range of but .0003″. Each dot on the chart is an average of four individual reels or spools of wire tested for diameters, so that these 25 points represent 100 actual measurements. The

Mr. Sternlof is a graduate of the University of Massachusetts and holds a degree of B.Sc in Chemistry and Mathematics. He has been associated with American Steel and Wire since 1928 as a chemist in the Electrical Cable Works. In 1948 he was appointed Division Product Engineer in charge of Quality Control.
His activities in Quality Control include: Senior Member of American Society for Quality Control, a founder of the Worcester section and its former chairman, former National Director of the A.S.Q.C., general chairman of the 6th N.E. Conference on Quality Control and an instructor in Quality Control at Worcester Junior College. He is also an Associate member of the American Institute of Management.
This paper was presented at the joint Ferrous and Non-Ferrous Divisions Technical session at the Annual Convention of the Wire Association in Detroit on November 8, 1954.

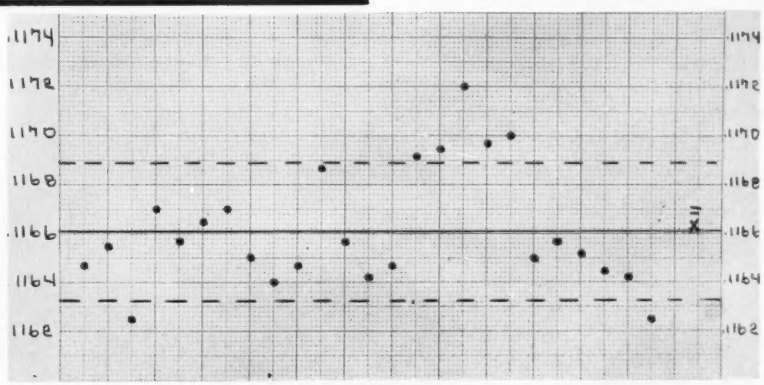

Chart I

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Enjoy exclusive features a

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• QUICK TRAVERSE TRANSFER—Push button-operated, the traverse transfers the wire quickly from full to empty reel. After it is transferred a solenoid-operated cutter snips the wire. The operator needs only to slide the fully wound reel off the driving shaft and replace it with another empty reel. The traverse mechanism is infinitely adjustable for wire lay and reel widths.

• PERMITS SPEEDS BEST SUITED TO YOUR NEEDS—To afford you greater control over the quality of your product, Davis engineering makes possible high and low operating speeds.

• STOPS WIRE DAMAGE AND BREAKAGE—To avoid wire damage or breakage, the dancer roll assembly is equipped with an automatic rheostat that reduces reel speed as the wire "builds up." Equipped with aluminum hardened sheaves for long wear. Uniform tension is controlled by adding weights to dancer roll.

• MINIMUM MAINTENANCE—Reel drive with silent chain is totally enclosed in oil. Unique design of machine employs heavy duty electric clutches that engage and disengage reel drives . . . instantly, positively. Equipped with electric brake. Mounted on a steel bed plate and fabricated of heavy duty welded steel, the Davis Dual Reel Take-Up is completely engineered and machined for proper alignment to insure minimum vibration and wear.

• SIMPLE TO INSTALL—Variable speed electronic drive, with 4-speed transmission and control station, is completely wired and mounted to the unit. Merely connect to power line and begin operations. Compact unit occupies a minimum of floor space.

WIRE AND CABLE MEASURING MACHINE

Predetermined or standard high speed counter with Quick Lever Reset handle; can be supplied with totalizers.

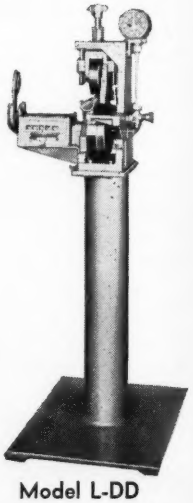
• PERMITS GREATER FLEXIBILITY IN YOUR WIRE HANDLING of covered or bare wire up to 1" diameter. Left or right hand assembly, for either direction of travel. Optional Tachometer to indicate wire speed in feet per minute can be provided.

• MEASURES ACCURATELY—It measures from the lower 18-inch circumference wheels to assure greater accuracy. A brake stops the measuring wheel the instant the wire leaves the machine.

• BUILT FOR LONG LIFE—Ruggedly constructed throughout. The measuring wheels are of hardened steel. To reduce friction and wear, roller bearings are used in upper and lower measuring wheels.

• COMBINES EASE WITH SPEED—There is a lift and lock on the top wheel to hold the wheel off the wire during set-up operations. The completely open side makes it possible to feed the machine without going through the guide bushings. Operates at speeds up to 2,000 feet per minute.

• OPTIONAL EQUIPMENT AVAILABLE AT LOW COST—Models that subtract . . . Guide Bushings . . . Wax Scraper . . . Light Signals . . . Can be equipped to record fractional feet, yards, meters.



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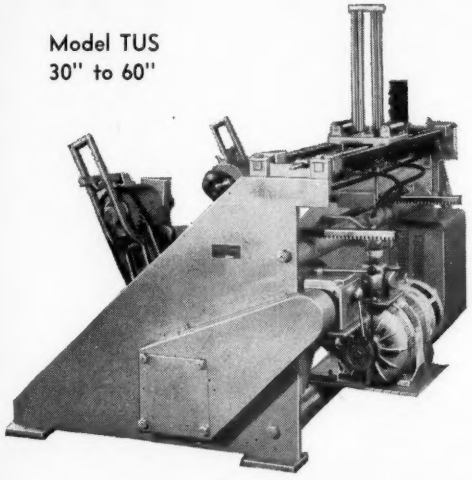


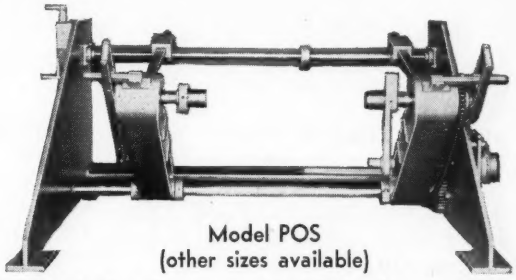
HEAVY DUTY SHAFTLESS TAKE-UP

For insulated wire and cable.

- EASY TO INSTALL—Infinitely variable-speed, Electronic drive and control station are completely mounted on the unit. Just connect to power line . . . it's ready to operate!
- SILENT-RUNNING—Reel drives are heavy roller and silent chain. Motor drives are belted, with 8-speed transmission.
- COMPLETELY ADJUSTABLE—Traverse mechanism is infinitely adjustable for wire and cable diameter.
- TAILORED TO YOUR NEEDS—Wire speeds and tension are fitted to your specifications. All other specifications of the Pay-Off, except drag brake, also apply to the Take-Up.

HEAVY DUTY SHAFTLESS PAY-OFF

For reels with outside diameter 30"-60"—adjustable width. For insulated wire and cable.



Model POS
(other sizes available)

- MACHINE DOES THE LIFTING—Mechanical positive lift, manually operated, easily raises and lowers reels off the floor to loading or unloading position. It shaves costs and speeds production by eliminating the need for cranes or hoists. Reel width adjustment controlled by handwheel.
- SHAFTLESS DESIGN CUTS ACCIDENTS—The need for reel shafts is eliminated; therefore, operator injuries from handling shafts are ended. Too, chances of accidents are cut because fewer motions are necessary to get the reel into position.
- STEPS UP PRODUCTION—Save time handling reels. Quick-change pintles readily fit reel arbor holes. The driving dog is adjustable to all reel driving holes. Reel pintles are mounted on ball bearings. Hand lever with self-locking device moves pintles to engage and disengage arbor holes. These features result in a smooth, continuous flow of work. No time is lost in changing reels. Supplied with free-running, or adjustable, electrical drag brake.
- LOW COST MAINTENANCE—No hydraulic or pneumatic cylinders to be maintained. Heavy steel plate stand. Reel arms are cast for high tensile strength. Both reel lift arms are mounted on rugged 3" steel shaft and supported by plate steel frame.

★ ★ ★

Wire and cable production of the highest quality is achieved with these four new Davis Electric Company machines. Their simple design and rugged construction keep maintenance to a minimum and make them safe and easy to operate. The adaptability of these units cuts costs as well as speeds up production. All these machines are easily installed.

The combination of the Davis Wire Measuring machine, Spark Tester, and Shaftless Pay-Off and Take-Up, make the ideal automatic re-reeling and spark-testing unit.

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process average, or grand average of all the measurements is 0.1166″ and the upper and lower control limits as calculated by the conventional $A_2\overline{R}$ method will be located at about 0.1169″ and 0.1163″, respectively.

★ ★ ★

As we look at this chart we see immediately that the process is definitely out of control with 5 points out on the high side and 2 points out on the low side. Furthermore, on closer study, the chart shows but 6 points above the nominal diameter and 19 points below.

★ ★ ★

First: The high resistance complaint. This, I said, could be caused by wires of low diameter.

★ ★ ★

The 25 points on the chart cover a long period of time and a great many set-up changes are involved. As the daily schedule calling for this wire size is drawn, a sample of four pieces from different reels or spools is selected at random and tested. It is possible that this particular wire size may not be drawn again for several days, or weeks, when a new set-up is made. From the chart it seems quite evident that all the 19 points below the nominal might have been drawn from a comparatively new starting die.

★ ★ ★

The engineers had calculated these wire drawing tolerances on the theory that a stranded conductor made up of wires drawn to these tolerances would be of the proper resistance. However, with these short runs with frequent set-ups, a new die of the starting diameter size does not have an opportunity of a steady long run. So no wire on the high side of the

Axel U. Sternlof

nominal is produced and consequently the strand is made up of wires produced on the low side of the nominal which gives us the high resistance. The quality control engineer then recommends that all short run production calling for this size of wire should be drawn with a minimum of .1165″ and not .1162″ in order to provide adequate electrical conductivity.

★ ★ ★

Second: The out of control situation. It is interesting to note that not a single individual reel or spool of wire tested from the 28 that are represented by the 7 out of control points was beyond specification tolerance. However, we must remember that the points plotted represent **samples** selected at random from a larger lot of wire. From the variations found, the quality control engineer makes his calculations of process average and spread, and can also make a very close estimate of process capabilities. However, this prediction cannot be made with any great degree of accuracy from a process that is out of control.

Ordinarily, the process of drawing copper wire is quite capable of holding to close tolerances with but little variation. Let us look at slide #2. Here we see illustrated the specifications of .1162″ to .1174″. In this range we find several normal frequency distribution curves. With a process capable of holding to little or slight variation, you can see that it is possible to get normal distributions all over the entire range of the specifications. Let us assume that today we are drawing wire in distribution #1. Were we to calculate control limits based on this distribution, our upper control limit would be far too low with respect to the upper tolerance, and, consequently, we would be reporting out of control points in great number in a very short time. Likewise with distribution #5, our lower control limit would be too high. This is, of course, based on the conventional $A_2\overline{R}$ method of calculating control limits. What we need, therefore, is some method that will recognize and take into consideration the variations within **and** between all these distributions.

★ ★ ★

I would like, therefore, to mention two methods of doing this, both of which are statistically sound. Let us first consider the use of so-called modified control limits. When you have a process that has proved that it is capable of performing a more accurate job than that called for by the tolerances, the use of modified control limits will permit of a wider process or operating band than will the conventional $A_2\overline{R}$ method. Let us now take a look at the same process some time later as shown in slide #3. Here the process average has been raised until now it is only slightly higher than nominal.

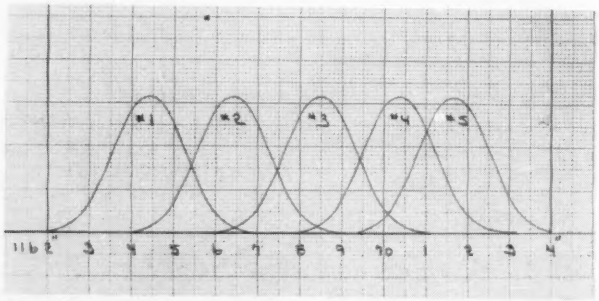

Chart 2.

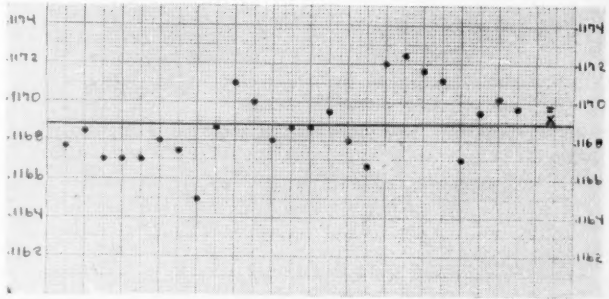

Chart 3.

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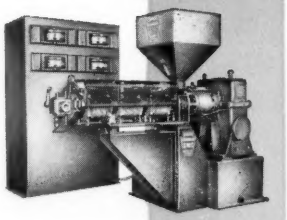
For coating wire with plastic — whether you need a single component or a complete installation — be sure to check with Davis-Standard.



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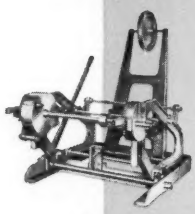

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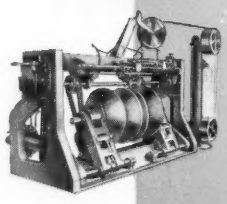

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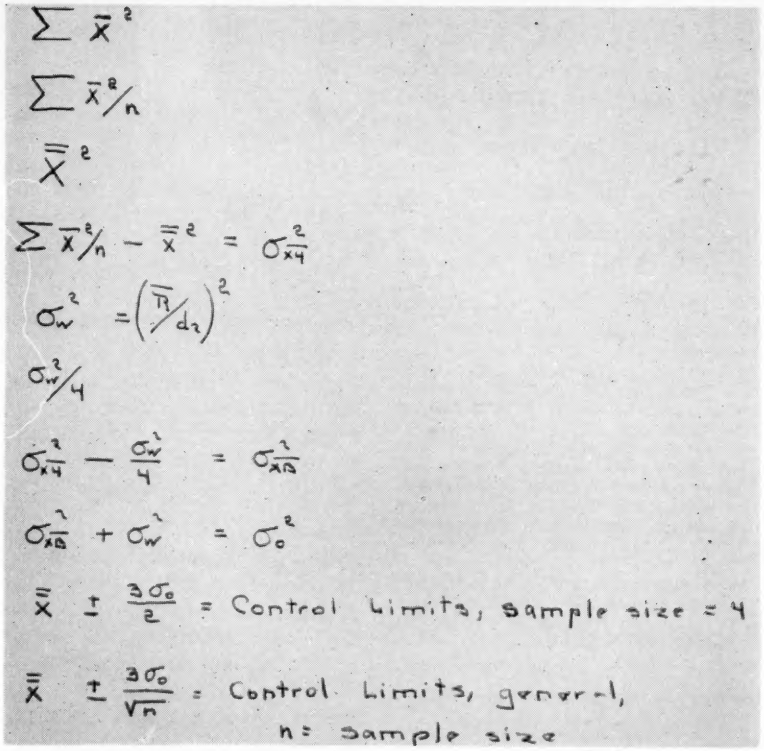
$\sum \bar{X}^2$
$\sum \bar{X}^2/n$
$\bar{\bar{X}}^2$
$\sum \bar{X}^2/n - \bar{\bar{X}}^2 = \sigma^2_{\bar{X}4}$
$\sigma_w^2 = \left(\bar{R}/d_2\right)^2$
$\sigma_w^2/4$
$\sigma^2_{\bar{X}4} - \frac{\sigma_w^2}{4} = \sigma^2_{\bar{X}n}$
$\sigma^2_{\bar{X}n} + \sigma_w^2 = \sigma_o^2$
$\bar{\bar{X}} \pm \frac{3\sigma_o}{2}$ = Control limits, sample size = 4
$\bar{\bar{X}} \pm \frac{3\sigma_o}{\sqrt{n}}$ = Control limits, general,
n = sample size

Chart 4

We shall now apply to this slide the control limits as calculated by the three methods.

★ ★ ★

A. The $A_2\bar{R}$ or conventional method. This consists of multiplying the average range by a constant, A_2, which constant varies according to the sample or subgroup size. The resultant product is then added to and subtracted from the grand average in order to determine the upper and lower control limits, respectively.

★ ★ ★

B. The modified method. After a process has demonstrated its ability to manufacture a product consistently within tolerances and with greater accuracy than that called for by the specifications, the use of so-called modified limits will permit of a wider operating band. This consists of multiplying the $A_2\bar{R}$ product by the square root of the sample size minus 1 or $A_2\bar{R}$ $(\sqrt{n-1})$.

★ ★ ★

The resultant figure is then subtracted from the upper specification limit and added to the lower specification limit in order to set our upper and lower control limits.

C. The total spread method. This method is more involved and is more technical than either of the other two, but with the use of a modern calculating machine, the entire calculation can be made in less than 10 minutes. Let us look at slide #4 as I explain the steps involved.

1. We get the sum of the squares of the sample averages.

2. The mean of the sum of these squares is then determined by dividing that sum by the number of samples.

3. We then square the grand average.

4. We then get the difference of the two squares. This is the variance of the averages.

5. We determine the variance within the sample by squaring the quotient obtained by dividing $\bar{R}$ by d_2, a constant dependent on sample size.

6. We apply a correction for sample size by dividing the variance within by 4, our sample size.

7. This correction factor is then subtracted from the variance of the averages to give us the variance between the groups of averages.

8. We then add the variance within to the variance between in order to get variance over all.

9. Extracting the square root of this over-all variance will give us the standard deviation or measurement of total spread.

10. Control limits are then calculated by multiplying this standard deviation by 3 and dividing this product by the square root of the sample size. The resultant quotient is then added to and subtracted from the grand average to get the upper and lower control limits, respectively.

★ ★ ★

(A word of caution: Step #7, the variance between the groups. In some instances, this will be a negative number, especially with sample sizes of 4 or less. In these cases we omit this type of calculation: it is the penalty or price we pay for using small sample sizes.)

★ ★ ★

Let us now look at slide #5. This is a schematic presentation or application of these various control limits to the tolerances under discussion. It is quite plain to see the advantages the modified and the total spread methods have over the $A_2\bar{R}$ or conventional method of calculating control limits.

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These two methods have been used with great success in jobshop or short-run installations and have saved needless time spent in hunting for trouble that did not really exist.

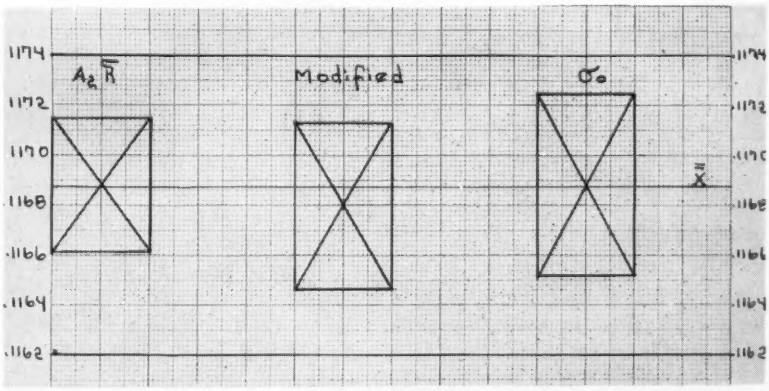

Chart 5

Allowable Working Stresses for Springs

by Harold C. R. Carlson, P.E.
Consulting Engineer
The Carlson Company
New York, N. Y.

This article describes the various types of service to which springs are subjected in Industry and includes a number of curves showing Allowable Working Stresses that will allow a long fatigue life for each type of service. Also, a set of curves showing the Endurance Limit depending on various stress ranges, that will allow 10,000,000 cycles of deflection, is provided. Included also are tables of spring design formulae and physical constants of all the popular spring materials.

This paper was originally presented at a Machine Design Division Meeting of the Metropolitan Section of the American Society of Mechanical Engineers on October 20, 1953.

Introduction

One of the oldest controversial subjects among engineers is the establishment of safe working stress values for springs. One of the reasons for this controversy is that a high working stress considered safe for one particular application can be quite unsafe for another application. Conversely, a low stress needed for some other condition may be far too conservative and uneconomical for use in another application. An examination of technical papers analyzing the problem and listing the results of fatigue tests will show that the tabulations of recommended stresses are not in agreement with one another. The principal reasons for these differences are that some data cover the results of tests made on only a few material compositions, and on only a few wire sizes; and some tabulations do not take into account the bad effects of dynamic loading, surface irregularities and high testing speeds, nor do they always allow for the good effects of pre-setting, shot-peening or proper stress equalizing heat treatments. The latest tests show that improvements in uniformity of material structure and composition, better surface finishes, and improved manufacturing operations combined with better wire drawing techniques, permit higher allowable stresses than ever before.

Purpose

The purpose of this article is to describe various types of service to which springs may be subjected, and to provide a set of curves (Figs. 5 and 6) to show the allowable working stresses that will permit a reasonably long fatigue life for such springs. Provided also are, a set of curves (Fig. 7) showing the endurance limit of springs for infinite fatigue life, tables of spring design formulae and tables of physical constants of spring materials required for design purposes.

Scope

Each set of fatigue curves showing allowable stress values (Figs. 5 and 6) covers the most popular spring materials in the full range of wire diameters commercially produced and in daily use by manufacturers of cold coiled springs.

★ ★ ★

The curves do not cover square or rectangular wire, special oversize wire, special alloys, hot rolled springs, clock, motor or power springs, flat, cantilever, or volute springs since such items usually require special tests for each type and size of material, and the results cannot easily be classified for general use.

★ ★ ★

The curves were made after an extensive review of existing technical literature, handbooks, manuals and publications, and supplemented by the results of actual laboratory tests combined with records of thousands of spring calculations and investigations made by the author during the past 20 years.

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In order to design springs and to properly use the curves, it is desirable to have some understanding of the theory of stress analysis as applied to structural members and curved beams. It is also necessary to have a correct interpretation of certain technical terms frequently used. At the risk of reiterating commonly known data, the following simplified definitions are presented:

Stress

Whenever a load or deflection is applied to a spring or structural member, a slight distortion is caused which tends to separate the tiny grains of the material. This external force is counteracted by the cohesive strength of the grains and this reaction or internal force is called stress. It is expressed in thousands of pounds per square inch regardless of the size of the section, for the sake of convenience, when comparing the actual stress with some known limiting or safe stress value.

Allowable Working Stress

This is the stress to which a spring may be safely subjected for a reasonable or desired number of times before failure occurs due to permanent set or to breakage. The numerical value of this stress (Figs. 5 and 6) will vary depending upon the type of service to which the material is subjected and upon a variety of operating conditions which are described later.

Modulus of Elasticity

This formidable sounding term is frequently used by engineers in formulas where deflection is concerned. It is derived from the Greek and means "measure of elastic ability." Actually, it is a measure of stiffness or rigidity. The lower the modulus, the more flexible is the material. By definition, it is the ratio of the stress intensity on a material to the unit strain produced within the proportional limit of the material. It is frequently called Young's modulus and is denoted by the letters E for tension, and G for torsion; sometimes it is called the modulus of rigidity. The values for both E and G are shown in Figs. 9 and 10. The elastic modulus in tensior is numerically equal to that unit stress which, if the ratio of strain to stress remained constant would double the length of a test specimen.

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The torsional modulus G is used for springs where the material is subjected to twisting, thus causing torsional stresses such as are found in compression and extension springs and rods used in torsion.

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The tension modulus E is used for springs where the material is subjected to bending or pulling, thus causing a tensile stress such as is found in torsion, flat, cantilever, clock and power springs.

Endurance Limit

When a spring is deflected continually it will become tired and fail at a stress far below its elastic limit. This type of failure is called Fatigue Failure and usually occurs without warning. Endurance Limit (Fig. 7) is the highest stress or range of stress, in pounds per square inch, that can be repeated indefinitely without failure of the spring. Usually 10,000,000 cycles of deflection is called infinite life and is satisfactory for determining this limit.

Fatigue Strength

This is the stress at which failure occurs after a definite number of deflections. It is always necessary to state the number of deflections when describing fatigue strength. The first set of curves (Figs. 5 and 6) show fatigue strength in relationship both to type of service and to number of deflections. Fatigue Strength is also called Endurance Strength.

Elastic Limit

This is the maximum stress that can be applied to a spring and still have it return to its original length upon release of load without permanent set.

Permanent Set

The difference in free length, if any, before and after deflecting a spring is called Permanent Set. The best designed springs using safe allowable working stresses should have no appreciable amount of permanent set.

Spring Formulas

Engineering handbooks frequently add to the confusion of spring design because they list different formulas for determining stresses, loads and deflections. This need not be confusing, however, when it is realized that the stress can be calculated either by using the load applied or by using the deflection. In the tables of formulas shown in Figs. 1, 2 and 3, two formulas are given for each property, and designers can use whichever one is most properly applicable, as the results from both formulas are the same.

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The load and deflection of compression and extension springs are always determined by the torsional stress. However, this is not the only stress in the spring. Additional stresses due to curvature, to bending, straight shear, and principally to the difference in fibre length between the inside of the coil and the outside, are also in the material. These stresses have little or no appreciable effect on the load or deflection but they should be considered when determining if a spring will take a permanent set, and also when long life is desired.

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To determine the total stress in a spring, the torsional stress should be multiplied by the Wahl curvature correction factor K, arrived at by the following formula:

$$K = \frac{4C-1}{4C-4} + \frac{.615}{C}$$

C = the spring index (mean coil diameter divided by the wire diameter). Values for K have been worked out for all conditions and are shown in various handbooks in both curve and tabular form. A simplified table sufficient for general use follows:

INDEX C	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0
K	1.58	1.53	1.49	1.46	1.43	1.40	1.38	1.36	1.34	1.33	1.31

INDEX C	5.4	5.8	6.0	6.4	6.8	7.0	7.4	7.8	8.0	9.0	10.0
K	1.28	1.26	1.25	1.24	1.22	1.21	1.20	1.19	1.18	1.16	1.14

Type of Service

The type of service to which a spring is subjected is one of the most important factors necessary for determining a safe working stress. This presupposes that consideration has been given to type of spring, kind and size of material, temperature, type of loading and so on. Three general types of service are shown on the allowable working stress curves (Figs. 5 and 6) based principally upon operating conditions as follows:

Light Service

This includes springs subjected to static loads and those having small deflections with low stress ranges and seldom used springs. Such springs usually have less than 1,000 deflections and seldom more than 10,000 in their lifetime.

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They are found in bomb fuses, projectiles, shock absorbers and safety devices seldom used. Such springs can be designed with relatively high stresses — often to

Fig. 1 SPRING DESIGN FORMULAE FOR COMPRESSION AND EXTENSION SPRINGS

PROPERTY	ROUND WIRE	SQUARE WIRE
Load P Pounds	$\frac{.393\ S\ d^3}{D}$	$\frac{.416\ S\ d^3}{D}$
	$\frac{G\ d^4\ F}{8\ N\ D^3}$	$\frac{G\ d^4\ F}{5.58\ N\ D^3}$
Stress, Torsional S lbs./sq.in.	$\frac{G\ d\ F}{\pi N\ D^2}$	$\frac{G\ d\ F}{2.32\ N\ D^2}$
	$\frac{P\ D}{.393\ d^3}$	$\frac{P\ D}{.416\ d^3}$
Deflection F Inches	$\frac{8\ P\ N\ D^3}{G\ d^4}$	$\frac{5.58\ P\ N\ D^3}{G\ d^4}$
	$\frac{\pi S\ N\ D^2}{G\ d}$	$\frac{2.32\ S\ N\ D^2}{G\ d}$
No. Active Coils N	$\frac{G\ d^4\ F}{8\ P\ D^3}$	$\frac{G\ d^4\ F}{5.58\ P\ D^3}$
	$\frac{G\ d\ F}{\pi S\ D^2}$	$\frac{G\ d\ F}{2.32\ S\ D^2}$
Wire Diameter d Inches	$\frac{\pi S\ N\ D^2}{G\ F}$	$\frac{2.32\ S\ N\ D^2}{G\ F}$
	$\sqrt[3]{\frac{2.55\ P\ D}{S}}$	$\sqrt[3]{\frac{P\ D}{.416\ S}}$
Stress due to Initial Tension S_{IT}	$\frac{S}{P} \times IT$	$\frac{S}{P} \times IT$

d = Diameter of round or side of square wire.
D = Mean coil diameter.

Fig. 2 SPRING DESIGN FORMULAE FOR TORSION SPRINGS

PROPERTY	ROUND WIRE	SQUARE WIRE
Torque (T) inch lbs. (also equals P·R)	$\frac{E\ d^4\ F^\circ}{4000\ N\ D}$	$\frac{E\ d^4\ F^\circ}{2375\ N\ D}$
	$\frac{S_b\ d^3}{10.2}$	$\frac{S_b\ d^3}{6}$
Stress, Bending S_b lbs/sq. in.	$\frac{10.2\ P\ R}{d^3}$	$\frac{6\ P\ R}{d^3}$
	$\frac{E\ d\ F^\circ}{392\ N\ D}$	$\frac{E\ d\ F^\circ}{392\ N\ D}$
Deflection F° Degrees	$\frac{4000\ P\ R\ N\ D}{E\ d^4}$	$\frac{2375\ P\ R\ N\ D}{E\ d^4}$
	$\frac{392\ S_b\ N\ D}{E\ d}$	$\frac{392\ S_b\ N\ D}{E\ d}$
Number of Active Coils N	$\frac{E\ d^4\ F^\circ}{4000\ P\ R\ D}$	$\frac{E\ d^4\ F^\circ}{2375\ P\ R\ D}$
	$\frac{E\ d\ F^\circ}{392\ S_b\ D}$	$\frac{E\ d\ F^\circ}{392\ S_b\ D}$
Wire Dia. d inches	$\sqrt[3]{\frac{10.2\ P\ R}{S_b}}$	$\sqrt[3]{\frac{6\ P\ R}{S_b}}$
	$\sqrt[4]{\frac{4000\ P\ R\ N\ D}{E\ F^\circ}}$	$\sqrt[4]{\frac{2375\ P\ R\ N\ D}{E\ F^\circ}}$
Inside Diameter After Deflection ID_1	$\frac{N\ (I.D.\ free)}{N + \frac{F^\circ}{360}}$	$\frac{N\ (I.D.\ free)}{N + \frac{F^\circ}{360}}$

d = Diameter of round or side of square wire.
D = Mean coil diameter.

within 5 to 10 per cent of the elastic limit of the material, and frequently above the elastic limit when a slight set is not objectionable.

Average Service

This includes most springs in general use such as those found in motors, brakes, switches, machines and mechanical products. Normal frequency of deflection and average use without shock loading permits such springs to operate up to 100,000 deflections with infrequent breakage, and the stress values shown by the average curves have often permitted over 1,000,000 deflections where the material and operating conditions were exceptionally good.

Severe Service

This includes those springs subjected to rapid deflections over long periods of time as in automobile and aircraft engine valves, pneumatic hammers, hydraulic controls and so on. The stress values shown by the curves provide for a minimum of 1,000,000 deflections, and it is recommended that these values be lowered by at least 10% to obtain 10,000,000 deflections, which is considered an infinite life for springs. For severe service use, it is also recommended that the endurance curves be considered before determining the safe allowable stress.

Question

A question frequently asked is "What is the safe stress for a spring?" A proper answer cannot be given quickly nor easily because consideration must first be given to numerous factors which affect the answer. They are as follows:

1. **Type—compression, extension, torsion, etc.**
2. **Size—small or large; long or short.**
3. **Material Type—steel, nickel, bronze, etc.**
4. **Material Size—light or heavy wire.**
5. **Type of Service—light, average, or severe.**
6. **Stress Range—low, average, or high.**
7. **Loading—static, dynamic, or shock.**
8. **Temperature—below zero or above normal.**
9. **Design—index, sharp bends, hooks.**

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Consideration should also be given to other factors that decrease spring life such as corrosion, buckling, friction, hydrogen embrittlement, and also to those manufacturing operations that increase the ability of springs to have a long life such as high-heat stress-equalizing, presetting and shot-peening.

Allowable Working Stress Curves

The allowable working stresses for springs vary over a wide range depending upon the considerations listed above. The values shown in the curves in Figs. 5 and 6, take into consideration type of material, wire size, type of service, average stress ranges, normal loading, room temperatures and normal indexes. They are for compression springs which do not buckle and

Fig. 3

SPRING DESIGN FORMULAS FOR FLAT SPRINGS

Based upon standard beam formulas where the deflection is small.

PROPERTY	PLAN	PLAN	PLAN	PLAN
Deflection F Inches	$\frac{P L^3}{4 E b t^3}$	$\frac{4 P L^3}{E b t^3}$	$\frac{6 P L^3}{E b t^3}$	$\frac{5.22 P L^3}{E b t^3}$
	$\frac{S_b L^2}{6 E t}$	$\frac{2 S_b L^2}{3 E t}$	$\frac{S_b L^2}{E t}$	$\frac{.87 S_b L^2}{E t}$
Load P Pounds	$\frac{2 S_b b t^2}{3 L}$	$\frac{S_b b t^2}{6 L}$	$\frac{S_b b t^2}{6 L}$	$\frac{S_b b t^2}{6 L}$
	$\frac{4 E b t^3 F}{L^3}$	$\frac{E b t^3 F}{4 L^3}$	$\frac{E b t^3 F}{6 L^3}$	$\frac{E b t^3 F}{5.22 L^3}$
Stress S_b Bending P.S.I.	$\frac{3 P L}{2 b t^2}$	$\frac{6 P L}{b t^2}$	$\frac{6 P L}{b t^2}$	$\frac{6 P L}{b t^2}$
	$\frac{6 E t F}{L^2}$	$\frac{3 E t F}{2 L^2}$	$\frac{E t F}{L^2}$	$\frac{E t F}{.87 L^2}$
Thickness t Inches	$\frac{S_b L^2}{6 E F}$	$\frac{2 S_b L^2}{3 E F}$	$\frac{S_b L^2}{E F}$	$\frac{.87 S_b L^2}{E F}$
	$\sqrt[3]{\frac{P L^3}{4 E b F}}$	$\sqrt[3]{\frac{4 P L^3}{E b F}}$	$\sqrt[3]{\frac{6 P L^3}{E b F}}$	$\sqrt[3]{\frac{5.22 P L^3}{E b F}}$

Fig. 4: COMPRESSION SPRING FORMULAS FOR DIMENSIONAL CHARACTERISTICS

Dimensional Characteristics	Type of Ends			
	Open or Plain (not ground)	Open or Plain with ends ground	Squared or Closed (not ground)	Closed and Ground
Pitch (p)	$\frac{FL-d}{N}$	$\frac{FL}{TC}$	$\frac{FL-3d}{N}$	$\frac{FL-2d}{N}$
Solid Height (SH)	(TC + 1)d	TCxd	(TC + 1)d	TCxd
Active Coils (N)	N = TC OR $\frac{FL-d}{p}$	N = TC − 1 OR $\frac{FL}{p} - 1$	N = TC-2 OR $\frac{FL-3d}{p}$	N = TC-2 OR $\frac{FL-2d}{p}$
Total Coils (TC)	$\frac{FL-d}{p}$	$\frac{FL}{p}$	$\frac{FL-3d}{p} + 2$	$\frac{FL-2d}{p} + 2$
Free Length (FL)	(p × TC) + d	pxTC	(p × N) + 3d	(p × N) + 2d

d = diameter of round or side of square wire.

are not subjected to corrosion. They are based on springs properly made by reputable manufacturers who take precautions to see that their springs are properly heated to relieve residual stresses caused by coiling. Other considerations such as angle of grinding, uniformity of pitch, eccentric loading, types of finish, vibration, resonance, natural period of vibration, harmonics and similar factors that might affect life and endurance are not covered by the curves.

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The values may be increased 20 to 30 per cent (but not beyond the elastic limit) for springs that are baked, pressed and then shot-peened. Although the curves are for compression springs, they also may be used for extension springs by reducing the values 10 to 15 per cent, and for torsion springs by increasing the values 50 to 60 per cent.

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All curves are based on the minimum torsional elastic limit of the wire as shown in the upper curves and these values should not be exceeded if permanent set is to be avoided. These values, however, may be increased 10 to 15 per cent due to the cold work caused by coiling, and stress equalizing by baking provided the springs are pressed solid after heating.

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The Wahl curvature correction factor is included in the curves for average and severe service only. The factor is not included in the curve for light service as it is seldom considered necessary for statically loaded or infrequently used springs.

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The reason for presenting this data in the form of curves rather than in tables is that small wire diameters have much higher allowable stress values than do the larger wire diameters. For example, the minimum elastic limit of a stainless steel wire .010 in. diameter is twice as high as for the same steel having .280 in. diameter.

Example

What is the allowable working stress for a compression spring made from .055 in. diameter music wire, for each class of service, and at what stress will it start to take a permanent set?

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From the music wire curves shown in Fig. 5, a vertical line running upward from the .055 in. wire diameter at the bottom of the chart will intercept the four curves as follows:

90,000 p.s.i. for Severe Service
120,000 p.s.i. for Average Service
135,000 p.s.i. for Light Service
150,000 p.s.i. for Elastic Limit where set occurs.

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The values shown are all on the safe side because the elastic limit curve in each chart is plotted from the minimum elastic limit in torsion of each material. In many cases the actual elastic limit may be 10,000 p.s.i. or more above the values shown by the curves.

Endurance Limit Curves

For severely worked springs such as those used in automobile or aircraft engines and in similar

Fig. 5: ALLOWABLE WORKING STRESSES FOR SPRINGS
(Fatigue Strength Curves)
For Compression Springs Made of Commercial Materials

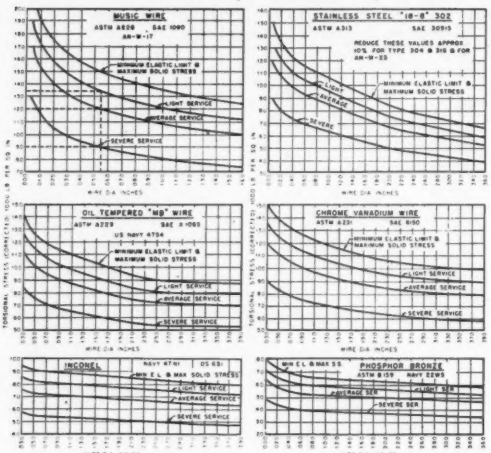
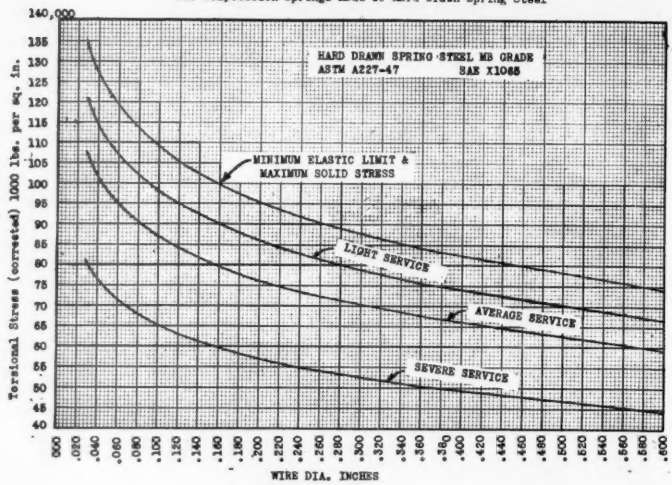


Fig. 6: ALLOWABLE WORKING STRESSES FOR SPRINGS
(Fatigue Strength Curves)
For Compression Springs Made of Hard Drawn Spring Steel


HARD DRAWN SPRING STEEL MB GRADE
ASTM A227-47 SAE X1065
MINIMUM ELASTIC LIMIT & MAXIMUM SOLID STRESS
LIGHT SERVICE
AVERAGE SERVICE
SEVERE SERVICE
Torsional Stress (corrected) 1000 lbs. per sq. in.
WIRE DIA. INCHES

applications, it is best to determine the allowable working stresses by referring to Endurance Limit Curves (Fig. 7). These are based principally upon the range or difference between the stress caused by the first or initial load and the stress caused by the final load.

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Most curves of this type previously issued did not include a qualifying factor for differences in wire sizes or elastic limits and therefore they should be used with care. The curves shown here are for compression springs having wire diameters less than 1/4" except as noted, and were plotted from existing data modified by the results obtained from later tests.

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Springs having stresses within the limits of the curves have had infinite or unlimited fatigue life. Such endurance limits, however, were based on 10,000,000 cycles to determine infinity and might require some modification for more deflections or for unusual operating conditions.

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The stress ranges may be increased 20 to 30 per cent for springs that have been properly heated, pressed to remove set and then shotpeened, provided that the increased values are lower than the torsional elastic limit by at least 10 per cent.

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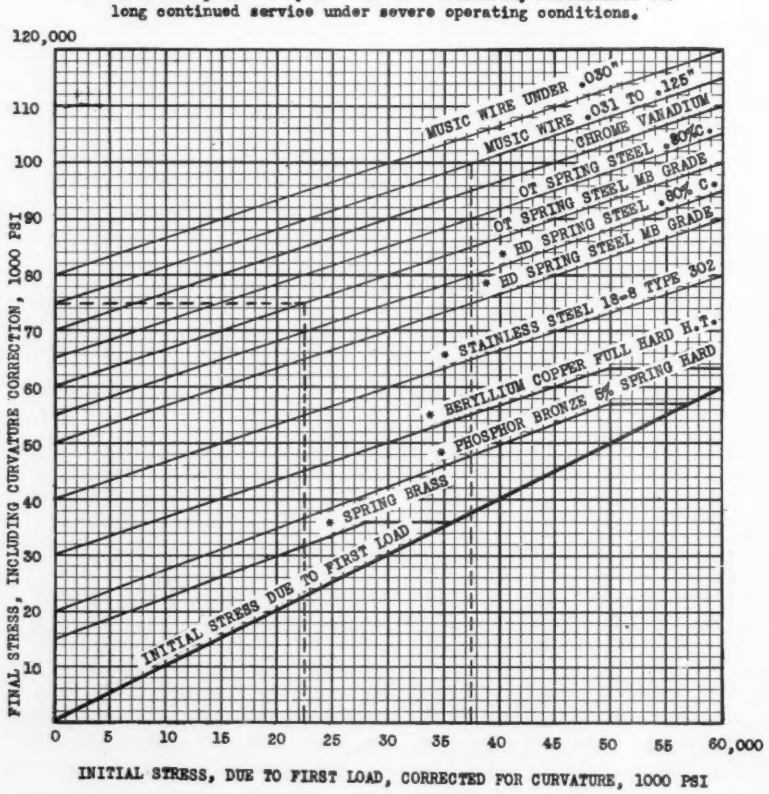
All values include allowance for Wahl curvature correction factor.

Fig. 7: ENDURANCE LIMIT CURVES

NOTE 1. For Compression Springs made from commercial spring materials with wire diameters up to 1/4" except as noted.

NOTE 2. The stress ranges may be increased approxmately 30% for properly heated, pre-set, shotpeened springs.

* Materials preceded by an * are not ordinarily recommended for long continued service under severe operating conditions.


MUSIC WIRE UNDER .030"
MUSIC WIRE .031 TO .125"
CHROME VANADIUM
OT SPRING STEEL .80% C.
OT SPRING STEEL MB GRADE
* HD SPRING STEEL .80% C.
* HD SPRING STEEL MB GRADE
* STAINLESS STEEL 18-8 TYPE 302
* BERYLLIUM COPPER FULL HARD H.T.
* PHOSPHOR BRONZE 5% SPRING HARD
* SPRING BRASS
INITIAL STRESS DUE TO FIRST LOAD
FINAL STRESS, INCLUDING CURVATURE CORRECTION, 1000 PSI
INITIAL STRESS, DUE TO FIRST LOAD, CORRECTED FOR CURVATURE, 1000 PSI

Example

What is the allowable working stress range for a compression spring made of phosphor bronze and for one made of oil tempered steel if the stress caused by the first applied load is 22,500 p.s.i.?

Fig. 8 Permissible Elevated Temperatures for Springs. Loss of load at these temperatures is less than 5% in 48 Hours.

SPRING MATERIAL	PERMISSIBLE ELEVATED TEMPERATURE	MAXIMUM RECOMMENDED WORKING STRESS P.S.I.
Brass Spring Wire	150° F.	30,000
Phosphor Bronze	225° F.	35,000
Music Wire	250° F.	75,000
Beryllium-Copper	300° F.	40,000
Hard Drawn Steel Wire	325° F.	50,000
Carbon Spring Steels	375° F.	55,000
Alloy Spring Steels	400° F.	65,000
Monel	425° F.	40,000
K-Monel	450° F.	45,000
Z-Nickel Type B	500° F.	50,000
Stainless Steel 18-8	550° F.	55,000
Stainless Chromium 431	600° F.	50,000
Inconel	700° F.	50,000
High Speed Steel	775° F.	70,000
Inconel X	850° F.	55,000
Chrome-Moly-Vanadium	900° F.	55,000
Cobenium, Elgiloy	1000° F.	75,000

Fig. 9 PROPERTIES OF SPRING STEELS

MATERIAL (Commercial Name)	SPECIFICATIONS IN GENERAL USE	MODULUS OF ELASTICITY	WEIGHT lbs.per cu.in.	RECOMMENDED ROCKWELL HARDNESS
Hard Drawn MB Spring Steel	A.S.T.M. A227-47 S.A.E. X1055 & X1060 Army 48-6A	G 11,400,000 E 28,500,000	.284	C41-C45
Music Wire Spring Steel	A.S.T.M. A228-41 S.A.E. 1085 Navy 22W11 Army 48-18 AN-W-17	G 12,000,000 E 30,000,000	.284	C42-C46
Oil Tempered MB Spring Steel	A.S.T.M. 229-41 S.A.E. X1065 Navy 47B4 Army 48TA Fed. QQ-W-474	G 11,200,000 E 28,500,000	.284	[illegible] -C46
Chrome Vanadium Alloy Steel	A.S.T.M. A231-41 S.A.E. 6150 Navy 46B31 Army 48-7A AMS 6455A	G 11,200,000 E 30,000,000	.284	C45-49
Silico-Manganese Alloy Steel	A.S.T.M. A59-49 S.A.E. 9260 Navy 46B31	G 10,750,000 E 29,000,000	.284	C43-C47
Silicon-Chromium Alloy Steel	Special	G 11,200,000 E 30,000,000	.284	C50-C54
Stainless Steel Type 302 (18-8)	A.S.T.M. A313-47 S.A.E. 30915 Navy 46S18	G 10,000,000 E 26,500,000	.288	C42-C47
Stainless Steel Type 304 (18-8)	S.A.E. 30905 Army 48-37 Navy 46S18	G 10,000,000 E 26,500,000	.288	C42-C47
Stainless Steel Type 316 (18 -12 MO)	S.A.E. 30805 Navy 47B21 & 22W13 AAN AN-W-23	G 10,000,000 E 26,500,000	.288	C42-C47
Stainless Steel Type 17 - 7 PH	Special	G 11,000,000 E 29,500,000	.276	C40-C45
Stainless Steel Type 414	S.A.E. 51210	G 10,500,000 E 28,500,000	.288	C43-C48
Stainless Steel Type 420	S.A.E. 51335	G 11,000,000 E 29,000,000	.280	C46-C51

A vertical line running upward from the bottom curve in Fig. 7, starting at a value of 22,500, intercepts the endurance limit curves as follows:

35,000 p.s.i. for phosphor bronze.
75,000 p.s.i. for oil tempered steel wire.

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And similarly, a spring made from 1/8" music wire with a stress of 37,500 p.s.i. initially, could have unlimited life provided that the stress caused by the final load did not exceed 100,000 p.s.i.

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It is extremely desirable to keep the final stress as far below the limiting value as possible to assure long life.

Elevated Temperatures

Springs used at high temperatures exert less load and have larger deflections under load than at room temperature. The modulus of elasticity, which determines deflection, is reduced with increased temperatures thereby causing greater deflection under load. The torsional modulus for steel may be 11,200,000 at room temperature, but it will drop to 10,600,000 at 400°F. and will be only 10,000,000 at 600°F. The elastic limit also reduces in value, thereby lowering the permissible working stress.

Recommendations

Design stresses should be as low as possible for all springs used at elevated temperatures. Corrosive conditions usually occur with high temperatures — especially with steam — and may require using a corrosion resistant material. Allow for 5% loss of load with torsional stresses (corrected for curvature) shown in Fig. 8. The temperatures listed may be increased 20° to 40°, but the loss of load may be nearer 10%. The stresses indicated are for compression and extension springs — they may be increased 75% for torsion and flat springs. The materials are in the heat treated or spring temper condition.

Conclusion

With the aid of the Allowable Working Stress or fatigue strength curves (see Figs. 5 and 6) contained in this article, engineers can easily select safe working stresses for the great majority of spring applications and can predict the fatigue life of springs with reasonable accuracy.

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Also, by referring to the Endur-

(*Please turn to page* 1359)

Composite Wires by Electroplating

by Edward C. Slick

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History and Development

The first use of metal by man was undoubtedly a great step in the advancement of civilization. Exact dates are not important to most of us now, but archeologists believe that copper and gold were used 10,000 years ago. The reduction of copper ore by use of charcoal probably occurred between 4,000 and 6,000 B.C. As time is measured in history, man soon learned to mix tin with copper to produce a relatively hard metal. We are told that the Egyptians and Greeks used wire of uncertain fabrication several thousand years ago, but it is believed that copper wire was first drawn in Germany back in the fourteenth century(1).

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From old tomb relics we learn that silver, gold and copper wire were used for ornaments, although there are indications that copper wire was used for other purposes such as rivets and fasteners. Several important properties are here established, corrosion resistance, strength and ductility.

Copper Wire Drawing a Major Industry

After the discovery of electricty in 1752 and the work accomplished by Volta, Faraday, Edison and others in the electrical field, copper wire became a major industry(1). The dynamo gave way to the development of copper refining by electrolysis and this made possible the high conductivity wire needed for the commercial development of power driven wire drawing equipment.

Numbers refer to references at end of paper.

Edward C. Slick

The author graduated from Pennsylvania State University in 1934 with a degree of B.S. in Metallurgy. He worked for Bethlehem Steel Company as a metallurgist in Johnstown from 1934 to 1943, joining his present company in 1943 as a member of the Metallurgical Research Laboratory engineering staff in Bayside, N. Y. There he specialized in metal properties as related to vacuum tube and electronic device applications. He was appointed to his current position in 1945.
His paper was presented at the Annual Convention of The Wire Association in Detroit on November 9, 1954.

Composite Metals

The manufacture of electrical power driven machinery and new products made increasing demands on metals with many properties not often found in one metal alone. As coating materials on wire, tin and zinc were hot dipped for many years. Zinc offered corrosion resistance to steel while tin improved appearance and solderability.

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The combination of high strength and conductivity required by the overhead electric power and communication lines brought on another method of producing bimetallic wires. In this instance, a heavy covering of copper is bonded to a steel core by pouring molten copper around a steel billet. The composite is hot rolled and cold drawn into wire.

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Throughout the years, before the war, the industrial markets became highly competitive. Manufacturers had to cut their costs and at the same time make their products more attractive. Competition and sales appeal have a way of bringing about industrial pressure for the development and application of engineering materials. Metallurgical Engineers were given the problem of developing better materials at lower costs. The demand for more attractive surfaces was also imposed on the electrochemist. Both of these groups turned to composite material by electroplating.

★ ★ ★

War always causes us to focus our attention on metals with high strength, corrosion resistance, heat resistance and many special properties. Again the engineers have turned to composite metals for many of these answers. War years and the years following are periods of metal shortages. The electroplater must answer the call to produce composites and overcome the short supply of nickel, copper, tin and others with which we are well acquainted.

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We seem to be entering a new era of material demands and

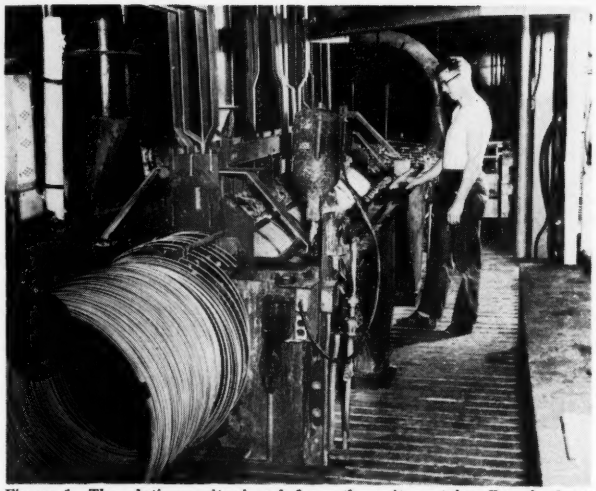

Figure 1—The plating unit viewed from the exit or take-off and of the tank. Cleaning and surface preparation compartments are in the rear to the right of the operator. Not shown in the photograph are nine selenium rectifiers which supply the unit with 1200 amperes.

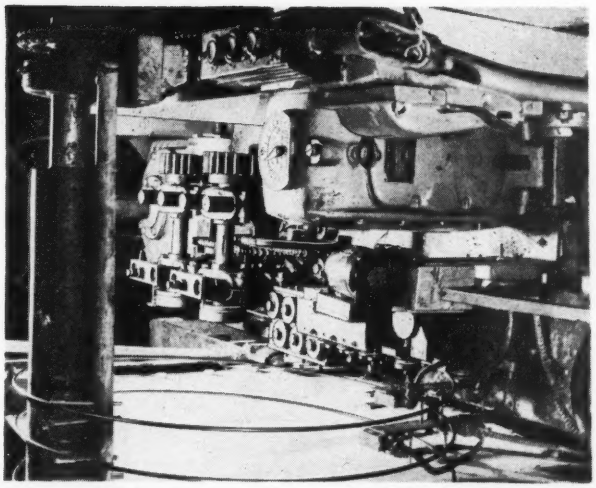

Figure 2—The base wire or rod to be plated passes through a set of straightening rolls and a helix forming mechanism before entering the tank.

there is no doubt that composite materials will play a major part in our future industrial and technical progress. The electronics field is expanding rapidly and the need for better materials is growing with it. The industry is placing the burden on us, as metal men, to produce inexpensive wires containing desirable engineering properties which are not available in a single metal.

The Electroplating Process

Continuous plating of wire has been used over a period of many years in the wire industry. This may take the form of a straight line unit or may be a coil type plating unit in which the wire feeds through the tank in a spiral form[2]. With the coil type unit, it is common practice to deposit plate thickness up to .020 inches on ¼ inch diameter wire and the same plate-to-base ratio will be found on the wire after being cold reduced. High production quantities can be plated in a small tank which occupies only a fraction of the space required by a conventional straight line unit.

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Such a tank may be described as a single unit, approximately twenty feet long, five feet wide and five feet deep, containing various compartments for cleaning, surface preparation and plating. A rubber roll extending over the entire length of the unit provides a method of support and driving the wire through the tank in a helicoidal fashion. To accomplish this the wire is straightened, then pre-formed to a uniform coil diameter. The coil diameter is maintained within limits to assure uniform plating thickness since the wire must pass between the curved inside and outside anodes in the plating compartment. The drive roll extends approximately four feet beyond the discharge end of the plating tank to act as the take-off and coiling spindle.

Surface Preparation

As the wire screws through the tank, the first compartments are utilized for cleaning and surface preparation of the base material. Since the composites will usually be cold reduced to fine wire, the plate adherence to the core is of major importance. Complete removal of grease, oil, oxides and other contaminates, is advisable by use of alkaline cleaners and acid dips.

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According to the generally accepted theory[3], the forces bonding the deposit to the base are atomic or chemical in nature. The adhesion, therefore, depends on intimate contact between the atoms and it may even be possible to increase the bond strength greater than the tensile strength of the plate or base material. The perfect bond might be one in which the atoms of the deposited metal grow as a continuation of the surface grains of the base.

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The alkaline baths may be made up using various combinations of sodium hydroxide, and such constituents as sodium metasilicate, trisodium phosphate, sodium sesquisilicate and others depending on the type of contaminant to be removed and the kind of metal to be plated[4]. The pyrophosphate and other complex phosphates are believed to aid in the prevention of hard-water scale while the orthophosphates contribute to the wetting and emulsifying action of the cleaner[4].

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When current is applied to alkaline baths, the metal is made either anodic or cathodic to evolve gas causing increased agitation at the metal surface[4]. We have found anodic or reverse-current cleaning to be best suited for the surface preparation of most heavy wires. This is particularly important since oxygen rather than hydrogen is evolved thus eliminating the possibility of hydrogen embrittlement when ferrous metals are being plated.

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It is often desirable to activate the surface in an acid with current to insure the best possible

adherence of the deposit. A good cleaning cycle will prevent blistering caused by trapped impurities and gas when the material is subsequently heat treated during further processing.

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The first acid solution contains diluted hydrochloric acid at R.T. to remove oxides, rust or scale. The second acid bath, a mild solution of sulphuric acid, is also held at R.T. and serves to activate the surface of the wire.

Plating

The continuous length of base wire having been thoroughly cleaned and prepared now enters the plating bath. To avoid possible confusion, it may be well to confine our remarks to one type of composite. For the purpose of this discussion, nickel on steel will be further considered.

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Since the rod or wire being plated may be cold drawn to fine wire sizes, a ductile coating must be deposited on the base metal. Fluoborate type electrolytes are known to deposit metals of high ductility and low stress. High buffering capacity, good conductivity, good throwing power, fine-grained deposits and high-speed operation are among the other desirable characteristics which make fluoborates popular for this purpose.

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The nickel electrolyte contains nickel fluoborate, nickel and boric acid[5]. Roehl and Wesley suggest the bath should generally be operated at a temperature of 130°F. and a pH of 2.7-3.5[5]. Operating parameters maintained within these limits should yield a smooth, fine-grained plate with excellent mechanical properties. Excessive current density at low bath temperatures may result in rough wire or a plate having low ductility. Under these operating conditions and with proper cathode-to-anode area ratio, little or no difficulty should be experienced in maintaining control of pH because of the high buffering capacity of this bath.

Bath impurities are of course, a very important factor in the deposit of a satisfactory plate. While the tolerance limits of impurities of fluoborate electrolytes are as good or perhaps better than the well known Watts and chloride type of baths, experience has shown that excessive amounts of iron and copper will cause plate discoloration, brittleness, high stress and pitting. To minimize the detrimental effects of impurities, it is necessary to periodically purify the bath by low current density deposition or by utilization of the principle continuously during tank operation. This may be accomplished in a separate tank, using a transfer pump to move a portion of the main bath continuously in and out of the auxiliary tank in which low current density plating is maintained. It is also desirable to include a filter in this system to remove accumulated dust and metal particles. Caution must be exercised in the use of a filter medium to make certain that it will not be attacked by the bath. A paper type filter aid has been found to be most satisfactory. For good operating control routine chemical analysis of the bath for nickel, boric acid, iron, copper and other metallic impurities is standard practice.

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Another factor of major importance to the deposition of a good metallic coating on heavy wire is that of anodes. The wire being plated and progressing through the tank in a helicoidal fashion, requires anodes which conform to a circular contour in order to maintain uniform current distribution and plating thickness. The exact shape is determined by the previously established coil diameter. Anodes are located both inside and outside of the progressing helix at a distance of approximately 8″ from the wire. This distance is important to insure uniform plating thickness around the entire surface of the wire. The anode surface, of course, must be adequate to maintain uniform anode attack and the proper anode-cathode ratio.

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High purity anodes are absolutely necessary, however, residual impurities present in commercial grade anodes require the use of bags or covering to prevent an excessive number of particles from being introduced into the bath. These particles may be attracted to the cathode surfaces causing a rough plate. It may be well to mention that cotton or similar types of anode bags have been found to be unsatisfactory due to attack by the fluoborate solution. Snythetic fibers such as

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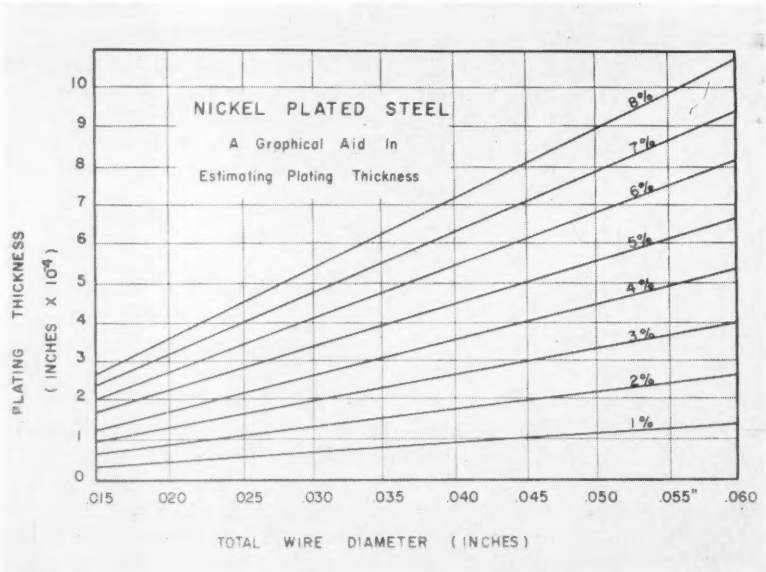

Figure 3—A useful chart for estimating nickel thicknesses plated on steel base wire. * * *

The Response to Heat Treatment of 18/8 Wires Given Various Percent Cold Reductions

by Samuel Storchheim
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In this article, one of a series the author has prepared for Wire and Wire Products on the processing of 18/8 stainless, he describes the effect of heat treatment of the wire in relation to cold reduction.

It is relatively well known that metastable austenite of the 18/8 stainless steel type can be converted into martensite by cold reduction. This phenomenon is aided by increasing quantities of niobium, chrome, silicon and molybdenum. The transformation is retarded by the presence of nickel, manganese and carbon. Because of the excellent corrosion resistance of stainless steel, its very fine mechanical properties and also the fact that a permanently magnetic structure can be induced in it, it has made it a natural for the field of magnetic recording. In lieu of this, the Wilbur B. Driver Co. set apart part of its research facilities in order to investigate the properties developed by cold working and heat treating 18/8 stainless steel wire. Some of the results of this research work have already been issued in other publications. (1, 2) This particular paper is a further extension of the information that has already been published. It discusses the response to heat treatment of wires that have received varying percentages of cold reduction of area. The first work, that is, the references referred to above, was based on the response of 18/8 stainless steel to cold work and the second article was based on the response to heat treatment of 18/8 stainless steel that had been cold worked previously to a magnetic condition.

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In order to accomplish the work for this particular report, two commercially available stainless steels were used for the experiments. One was a 304 type, while the other was a 302 type stainless, the analyses of which are given in Table I. Both wires were reduced extensively, that is, cold reduced, and were then given very low temperature anneals, namely 1225°F, the wire being at temperature approximately 9 seconds in a cracked ammonia atmosphere. The reason the wires were given such a low temperature anneal was to only partially convert the existing martensite of the previously cold worked stainless steel wire to austenite. This latter phase is relatively soft and ductile and can be readily cold deformed. By using this particular technique, it was possible to further cold draw the wire, without any difficulties, to a very highly magnetic state, that is, we were able to almost completely transform all the austenite to martensite.

TABLE I

CHEMICAL ANALYSIS BY PERCENT

Analysis No.	Stainless type	Ni	Cr	Mn	Si	C	Mo approx.	Fe
1	302	9.01	18.62	0.89	0.42	0.100	----	balance
2	304	9.11	18.77	0.56	0.55	0.065	0.34	balance

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Once the wires had been cold drawn and partially annealed, they were all drawn to 0.004" diam. and were then heat treated at various temperatures. When the heat treatment was completed, specimens from each sample were taken and were tested for their magnetic parameters; this included, remanence, Br, and coercive force, Hc. These measurements were made in a hysteresis loop tester which was described in reference 1. The diameters of the low temperature annealed wires were so arranged that when they were cold drawn to 0.004" they had received reductions in the order of 80%, 94% and 98%. The data obtained from these wires are tabulated in Tables II and III and represent the Analysis 1 and 2, respectively.

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Before going into the details of these data, and their presentation in plotted form, it might be wise to discuss the previous results found, that is, the results given in references 1 and 2. Figs. 1 and 2 show plots of the magnetic parameters Br and Hc, resp., vs. percent cold reduction. It was learned that the remanence increased as percent reduction increased and coercive force decreased as percent reduction of area increased, see Figs. 1 and 2, resp., Figs. 3 and 4 show plots, respectively, of the reman-

TABLE II

MAGNETIC MEASUREMENTS OF WIRES REDUCED VARYING PERCENTAGES AND PARTIALLY ANNEALED AT 1225°F

Analysis No. 1

% Reduction	Coercive Force, oersteds	Remanence, gausses
98	160	7500
90	160	3250
67	220	500
	Analysis No. 2	
98	300	3240
90	180	2750
67	520	200

ence and coercive force vs. temperature of heat treated wire originally in a fully martensitic condition. The remanence rapidly decreased while the coercive force increased, until the wires became fully non magnetic, that is, all the martensite was converted to non magnetic austenite. Thus we see that cold work increases the remanence and decreases the coercive force, while heat treatment decreases the remanence and increases the coercive force.

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In order to observe clearly the effect of temperature on the magnetic parameters on the stainless steel wires investigated, Figs. 5 through 8 were plotted. The remanence values of Analysis No. 1 were plotted vs. the heat-treating temperatures. The three curves depicted represent wires of three different percentages of cold reduction, namely, 80, 94 and 98%. In all cases the curves show a decline in remanence as temperature is increased. The indication is that decline is more severe the greater the percentage of cold reduction, in fact, the curves representing both 94 and 80% reduction of area show portions where very little change in remanence is observed as the temperature is raised. This appears to be even more marked for

TABLE III

Analysis No. 1

98% Reduction of Area

Temp.,		Coercive Force, oersteds	Remanence, gausses
635°C	(1180°F)	40	10500
640	(1190)	60	10000
645	(1200)	165	6080
650	(1210)	165	6500
655	(1220)	180	5000
660	(1230)	240	3750
665	(1240)	260	2960
670	(1250)	300	2070
		94% Reduction of Area	
635	(1180)	105	9500
640	(1190)	175	6500
645	(1200)	180	6550
650	(1210)	200	1520
655	(1220)	210	6150
660	(1230)	240	4800
665	(1240)	290	2950
670	(1250)	295	2660
		80% Reduction of Area	
635	(1180)	380	3700
640	(1190)	420	2520
645	(1200)	440	2260
650	(1210)	400	2660
655	(1220)	400	2800
660	(1230)	420	2130
665	(1240)	430	1860
670	(1250)	440	1480

TABLE IV

Analysis No. 2

98% Reduction of Area

Temp.,		Coercive Force, oersteds	Remanence, gausses
635°C	(1180°F)	120	6000
640	(1190)	190	5250
645	(1200)	230	3000
650	(1210)	280	3720
655	(1220)	290	3990
660	(1230)	360	2470
665	(1240)	420	1770
670	(1250)	480	960
		94% Reduction of Area	
635	(1180)	360	2840
640	(1190)	440	1600
645	(1200)	460	1060
650	(1210)	460	1520
655	(1220)	450	1720
660	(1230)	500	1200
665	(1240)	520	520
670	(1250)	540	800
		80% Reduction of Area	
635	(1180)	560	900
640	(1190)	560	520
645	(1200)	560	430
650	(1210)	540	680
655	(1220)	540	540
660	(1230)	520	350
665	(1240)	540	350
670	(1250)	520	200

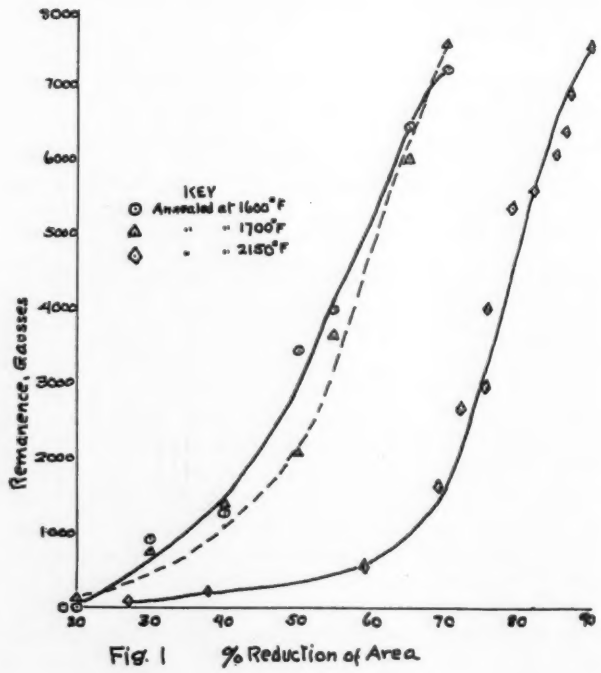


Fig. 1

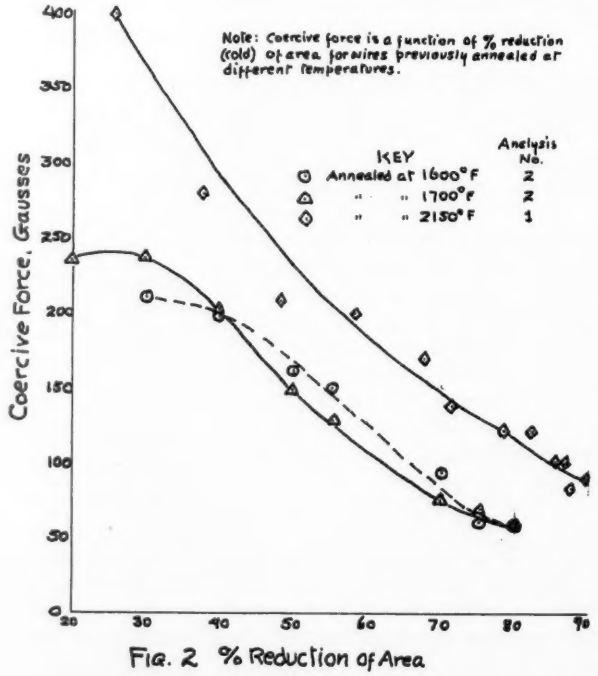


Fig. 2

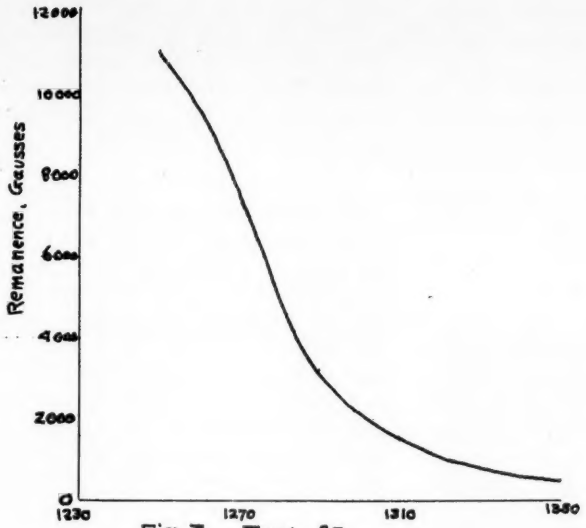
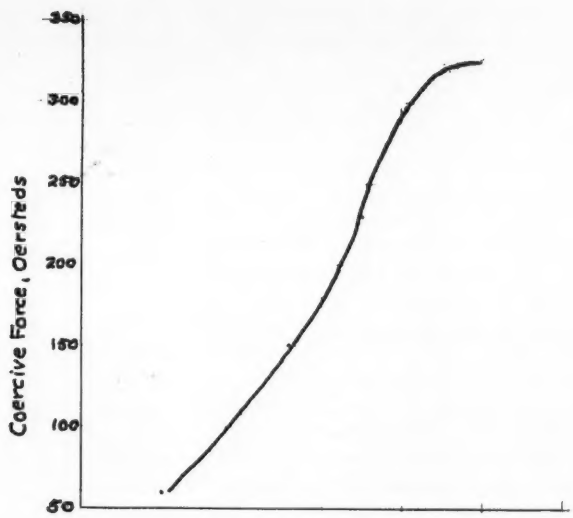


Fig. 3



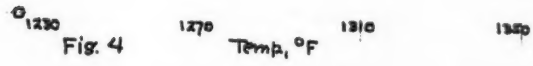


Fig. 4

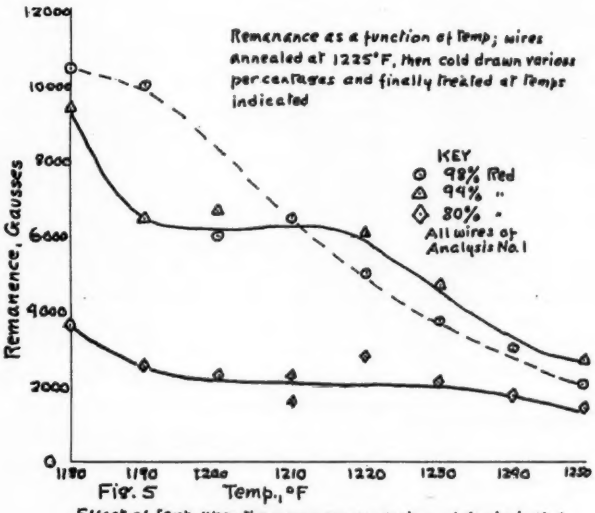


Fig. 5

Effect of Temp. upon the remanences of wires of Analysis No. 1 cold drawn various percentages

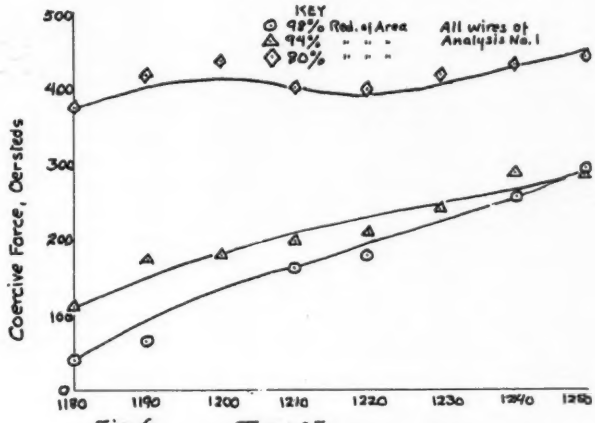


Fig. 6

Same as Fig. 5 except effect upon the coercive forces.

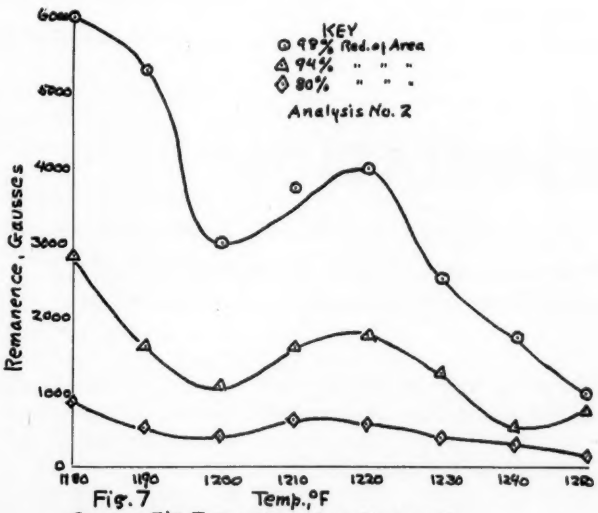


Fig. 7

Same as Fig. 5 except Analysis No. 2 used.

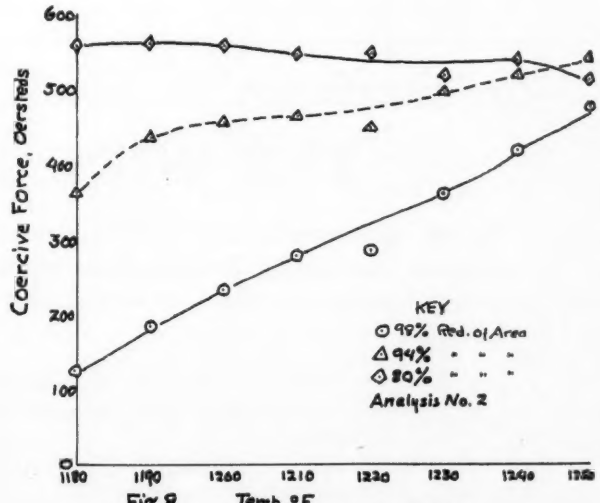


Fig. 8

Same as Fig. 6, except Analysis No. 2 used.

the 80% reduction curve than for the 94% reduction curve.

★ ★ ★

Fig. 6 was plotted of data taken from the same wires as used for Fig. 5 with the exception that coercive force was plotted instead of remanence vs. temperature. All three curves indicate a rise in coercive force as heat-treating temperature is increased. The rise appears to be at a more rapid rate for the more severely reduced wires. The highest coercive forces are developed for the 80% reduction of area specimens. This particular curve appears to be almost flat over a considerable range of heat treating temperatures. This seems to be in keeping with the data of Fig. 5, that is, over a wide range of temperatures the remanence values appear to be relatively constant, which indicates that the 80% reduction of area specimens were less susceptible to the conversion of martensite to austenite by heat treatment. This of course can be a very practical observation from the standpoint of producing wires of a required Hc-Br range. The engineer in charge of this type of production would probably be wise to choose wires reduced 80% rather than 98% so that he can allow his heat treaters the maximum range of temperature variation during production heat treatment.

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Fig. 7 represents wires treated identically to Fig. 5 with the exception that the wires came from Analysis #2 rather than Analysis No. 1. Here the same trends are observed, that is, all curves exhibit decreasing remanences as temperature of heat treatment is increased. In addition, the curves are displaced downward as the percent reduction of area is decreased. Finally, the slopes of the curves decreased as the percent reduction of area decreases.

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Fig. 8 is similar to that of Fig. 6 with the exception that Analysis #2 was used in this case. As observed previously the curves of 98 and 94% reduction show an increase in coercive force with increasing temperature, however, the curve representing the 80% reduction of area specimens no longer indicates an increase, but rather a slight decrease of coercive force as the temperature of heat treatment is increased. This latter result possibly can be explained in the following manner: the conversion of martensite to austenite reduces the remanence because less magnetic material is available. The coercive force developed is possibly dependent upon the amount of stress set up where the martensite and islands of austenite interfaces exist, that is, these are areas of the greatest lattice mismatching. The more the coversion of martensite to austenite, the greater are the amounts of areas of mismatching; the greater the stresses set up, and therefore, the greater the coercive forces developed. However, the point is reached where less of the areas of mismatching exist, because most of the martensite has been converted to austenite and now fewer areas of mismatching exist and thus less stress also exists. This could, therefore, tend to account for the slight decrease in coercive force observed.

★ ★ ★

By comparing Figs. 5 and 7, that is, the remanence vs. temp. curves for analysis 1 and analysis 2, resp., it is observed that in all cases for the same percent reduction of area the analysis #2 curves are lower than those of analysis No. 1. The indication here is that the nickel content of analysis #2, which is higher than analysis #1, is responsible for the lower remanence induced in the wire.

★ ★ ★

If Fig. 6 and Fig. 8 are compared, that is, the Figs. for coercive force vs. the temperature of heat treatment for analysis #1 and analysis No. 2, resp., it is seen that the Hc values developed for analysis 2 for the same percent reduction of area are always higher than those of analysis #1. This is logical because it has been found that as remanence increases, coercive force decreases and visa versa. Thus the higher remanence values of wires of Fig. 5 would tend to exhibit lower coercive force values than those exhibited by Fig. 7 for analysis #2.

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An Invitation to Join

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To you gentlemen of the Wire Industry who attended our Silver Anniversary Annual Convention in Detroit as guests, we extend a cordial invitation to unite yourselves in our work of furthering the interests of our industry through membership.

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RICHARD E. BROWN, Executive Secretary

453 Main Street **Stamford, Conn.**

Rigid and Semi Rigid PVC Insulations

by J. L. Foster
Product Engineer, Plastic Materials
B. F. Goodrich Chemical Company
Cleveland, Ohio

A short historical background on the development of polyvinyl chloride resins would probably be helpful before we attempt to discuss a subject such as, "Rigid and Semi-Rigid PVC Insulations."

★ ★ ★

Polyvinyl chloride, as a material, has been known for about 80 years. The utility of PVC, however, was not recognized until the late 1920's. Dr. Waldo Semon of The B. F. Goodrich Company, in a program on synthetic rubbers, in **1927,** discovered that PVC was soluble in certain high molecular weight solvents at elevated temperatures, and cooled to give a gel structure which had valuable properties not common to other materials under investigation.

★ ★ ★

It was this first plasticization of the resin that has led to the widespread use of vinyl materials as wire insulation, cable jacketing, film, sheeting, and molded products of all types.

★ ★ ★

In the early years of vinyl compounding, the number of plasticizers available for use with PVC resins was very limited. Equipment was also a drawback to successful handling of the materials—normally, rubber equipment, which did not have the proper temperature ranges or controls, was modified for the extrusion, calendering and molding of vinyl compounds. Nevertheless, as knowledge was accumulated as to the properties which the various available plasticizers would impart to PVC, formulations were developed which could be handled on available production equipment. Most of these compounds were in the hardness range of 75-85 on the Durometer A scale —or what are now classified as flexible vinyl compounds.

J. L. Foster

The author was graduated from Kansas State College in 1937 with a degree of Bachelor of Science in Industrial Chemistry. He has worked for the company for ten years, the last six as a product engineer on wire and cable materials. His paper was presented at the Annual Convention of The Wire Association in Detroit on November 9, 1954.

★ ★ ★

As the vinyl resin field has expanded, research work has added many new plasticizer systems which have given added properties to PVC compounds. The temperature range for flexible vinyl compounds has, for example, been expanded in both directions. Within a still fairly narrow hardness range, vinyl compounds can now pass —55°C up to +105°C.

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In addition to the vast improvements in types and properties of plasticizers, new vinyl resins have been developed for easier processing. Copolymer and terpolymer systems with vinyl chloride have been made which can be handled without additional plasticizer. This paper will not concern itself with this type of rigid compound, however, since the ease in processing was made possible only at a sacrifice of certain other properties—physical and electrical. For maintenance of optimum properties for wire and cable uses, we will concern ourselves only with straight polyvinyl chloride resins.

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Extrusion equipment manufacturers have also developed special machines for handling thermoplastic materials. The use of longer barrels, shallower screws, higher temperatures and other modifications have been responsible, to a large degree, for the types of materials which can satisfactorily be extruded and for the high wire speeds which are common in the wire and cable industry today.

★ ★ ★

The flameproof properties of vinyl jacket compounds led to their adoption for shipboard cable use during World War II. This and the other excellent properties of vinyl insulations and vinyl jackets has resulted in continued growth to where millions of pounds of compounds are used yearly in this field.

★ ★ ★

This growth and current usage of PVC compounds is in spite of the well recognized fact that compounding ingredients — particularly plasticizers — destroy, partially at least, the very excellent electrical properties of PVC resins. The following table of data will give a comparison of several properties at 25°C.

TABLE

Dielectric Constant	Geon 2046	Unplasticized Geon Compound
1 x 10^3 cps	6.10	3.10
1 x 10^6 cps	3.55	2.94
Dissipation Factor		
1 x 10^3 cps	.110	.015
1 x 10^6 cps	.089	.011

★ ★ ★

Certain plasticizers will also adversely affect heat and light stability, low temperature and other physical properties of the base resin.

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It was quite logical, therefore, that efforts be made to remove — or at least to reduce — the "harmful" compounding ingredients in vinyl wire compounds. With the experience gained in resin production, with the added know how in vinyl processing and with the newer extrusion machines, tremendous strides have already been made in this direction. We have extruded thousands of pounds of compounds containing plasticizer in the range of 20-30 parts per hundred parts of resin. These compounds have been based on ester type plasticizers as well as on the resinous types. Wire speeds have been in the same range as for flexible compounds.

★ ★ ★

We have also extruded completely unplasticized stocks. Some of the problems involved in handling this type of material will be discussed later.

★ ★ ★

I would like to point out at this time that additional modifications of extrusion equipment may be necessary for the rigid type PVC compounds. This should not be surprising when the history of vinyls is reviewed. The modifications necessary in rubber tubers for handling of vinyls is well known in the industry. Likewise, the further modifications for handling powder mixed vinyls, are well known.

★ ★ ★

Before delving deeper into the subject under discussion, let us first define the terms rigid and semi-rigid PVC materials. One of the arbitrary definitions of flexible, semi-rigid and rigid plastic materials can be based on hardness. Generally speaking, any vinyl up to about 95 "A" or 70 "C" in hardness (Durometer scales) is classified as a flexible material. The 70 "C" to 90 "C" hardness range can be classified as semi-rigids and anything harder than 90 "C" can be classified as a rigid. This classification is followed by our company.

★ ★ ★

Rigid types of PVC materials are currently in production as sheet material, as pipe and other extruded sections and as molded and formed items.

★ ★ ★

One of the main problems in handling the rigid vinyls is in controlling the stock temperature build up because of frictional working. This can cause problems in mixing on mills or in Banburys as well as in extrusion operations. Those of you who have run 6″ and larger extruders on flexible vinyl compounds are aware that frictional working can raise stock temperatures as much as 100°F. — particularly at higher worm speeds. With rigid PVC compounds, lubrication must be properly controlled to prevent a rise in temperature way beyond that encountered with flexible materials. From work that has been done with all types of thermoplastic extrusion machines, it is obvious that modifications in machine design can do much towards the elimination of some of the current handling problems. The plastics equipment manufacturers are well aware of the problems and work is being done on new design machines.

★ ★ ★

Pipe extrusion techniques for rigid vinyls have, at this point, been well developed. Compounds can be extruded from hot strip, from granules or from powder mixes on most types of extrusion equipment. There are, of course, as we have previously discussed, optimum designs which do the best possible job.

★ ★ ★

The translation of this pipe extrusion know how to the wire and cable field is not as easy as it might seem. As a matter of fact it is actually extremely difficult.

★ ★ ★

In the first place, complete compound modifications have to be made to meet the stringent electrical requirements for wire insulation. Compounds designed for use as pipe are formulated with fillers, lubricants, processing aids, etc. which are chosen strictly for extrusion characteristics. A good share of these materials can or will adversely affect electrical properties. This means, simply, that wire coating can not be as easily compounded for extrusion characteristics as can pipe compounds.

★ ★ ★

Extrusion machine variations which have been found optimum for the processing of rigid vinyl pipe can be translated directly for wire and cable uses. These variations include the use of 15-1 to 20-1 length to diameter ratio screws with compression ratio in the range of 1½-1 to 2-1.

★ ★ ★

Actual extrusions on wire are entirely a different matter. The increased frictional working of these rigid compounds in being forced through small orifice dies and the increased flow problem around the normal 90° bend and through smaller channels add numerous headaches.

★ ★ ★

The problem of residual strains on the surface are not too important in heavy wall pipe. Such strains are all important in thin wall insulation, however, since they can cause failures on accelerated aging tests, on heat shock tests or on low temperature tests. Work done by the sales development laboratories of B. F. Goodrich Chemical Company has indicated that such strains can be relieved by reverting to the old techniques of annealing the insulated wires. On a series of semi-rigid compounds, we have found that this annealing can be done by using hot water — around 160-170°F. — in the cooling trough. The only problem involved with this sort of operation is the possibility of deforming the wire on the capstans or take up equipment. A

dual cooling trough of hot water followed by cold water would eliminate any such problems.

★ ★ ★

The use of 45° crossheads instead of the usual 90° heads would eliminate many of the flow problems with rigid compounds. A large portion of our developmental efforts on wire insulations are, at the present time, being directed towards the solution of such problems.

★ ★ ★

We are, of course, attempting to follow an orderly precedure in our work. Up to this point, most of our work has been done on the semi-rigid classification of materials. Our discussion, from this point on, will be directed towards these semi-rigid formulations.

★ ★ ★

Geon Plastic 8725 is a good example of a semi-rigid compound. This compound has a hardness of 77 "C", a specific gravity of 1.35, a tensile of 2850 psi, and an elongation of 335%. This compound has been approved as a cable jacket under the requirements of specification MIL-C-2194. TSGA-150 cable has been extruded on a double extended #4 Royle extruder with conditions as follows:

Screens	2 - 20 mesh
Cylinder temperature	270°F.
1st Cylinder Extension temp.	270°F.
2nd Cylinder Extension temp.	285°F.
Head temp.	345°F.
Breaker Plate temp.	345°F.
Die Holder temp.	340°F.
Stock temp.	380-400°F.
Exit Warm Water temp.	170°F.
Worm Speed	16 RPM
Cable Speed	15 RPM

★ ★ ★

TSGA-150 cable is approximately 1½" in diameter. The cable core has a tape wrap, a jacket and an aluminum braid. The cable is given severe tests of flame resistance and current overload. In the latter test the jacket temperature may reach 125-130°C. Under this condition, the jacket must not exude through the outer aluminum braid. Geon 8725 has passed all requirements of the specification with flying colors. A sample of this cable is available for your inspection.

★ ★ ★

As with flexible compounds, semi-rigids may be made either with ester plasticizers or with polymeric plasticizers. Because of increasing aging requirements, the large volume use of semi-rigid compound will probably be those based on polymerics. The use of the newer, low volatility phthalates may also well be large because of the extremely good outdoor aging qualities.

★ ★ ★

The compounding of semi-rigid compounds is similar to that of flexible materials. One of the main differences is the need for increased lubrication to avoid overworking the compound on the screw. The choice of lubricants will be limited but will normally be a high melting point wax such as Carnauba or Acrawax C. A second difference is obvious once the extrusion conditions have been studied.

★ ★ ★

Most semi-rigid compounds, for maximum properties and ease of extrusion, are run at stock temperatures around 400°F. This means that a careful consideration of the stabilizer system is needed. Norm-

(*Please turn to page* 1369)

Table I

Properties:	Compound "A"	Compound "B"
Specific Gravity	1.34	1.36
Hardness	88"A"	89"C"
*Original Tensile, psi	3200	3600
*Original Elongation, %	300	250
*Retention of Elongation, % after 4 days @ 136°C.	92%	100%
*Low Temperature flex 2" mandrel -35°F.	pass	pass
-85°F.	fail	pass
Insulation resistance @ 22°C megohms-1000 ft. 10 mil wall	100	850
32 " "	400	3500
*Heat Resistance 4 days @ 150°C. Shrinkage	none	none
Dielectric Strength test of MIL-W-16878A	pass	pass
*Flame Resistance MIL-W-5086 test	pass	pass
*Humidity Cycling per MIL-E-5272 I.R. per 200 ft. @ 22°C original	500	4250
after 15 cycles	15	1500
Copper Corrosion	none	none

* 10 mil wall on #20 wire.

Table II

	TW Compound	Semi Rigid Compound
Deformation-UL Test	36%	26%
Insulation Resistance megohms-1000 ft @ 15.6°C.	3000	4000
Compression Resistance	1100#	2200#
S.I.C. -30°C, 1000 cps 1 day	5.18	3.22
1 week	5.32	3.19
2 weeks	5.34	3.16
Power Factor-30°C, 1000 cps 1 day	8.14	9.28
1 week	8.14	8.54
2 weeks	8.34	8.48

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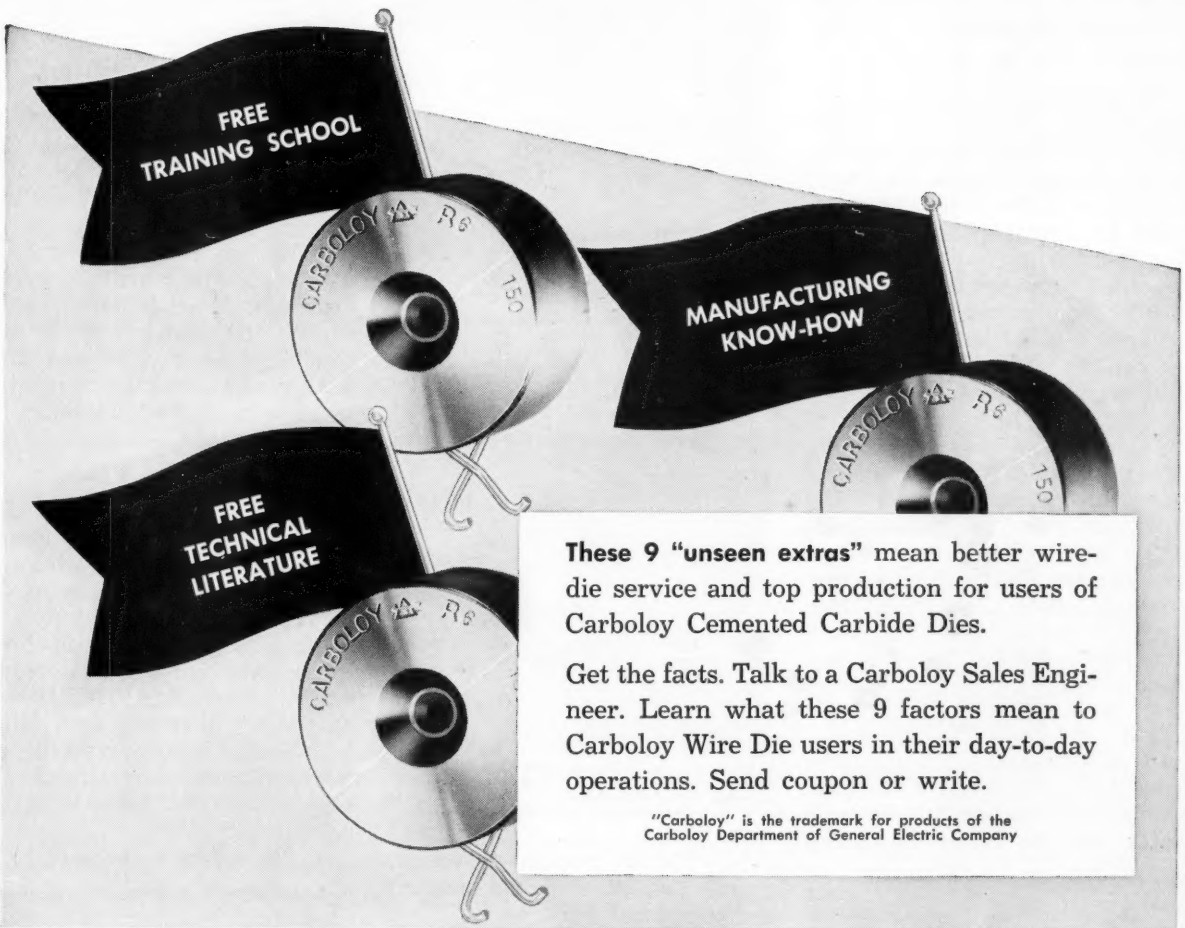

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Uses of Steel Wire Growing

by Kenneth F. Maxcy, Jr.
Pittsburgh Steel Company
Pittsburgh, Pennsylvania

How a manufacturer of wire is co-operating with a wire product fabricator to increase the use of steel wire products is described in this article.

The uses for steel wire are taking on a big fast-growing new dimension. Design and production of formed wire products is expanding so fast there has been little effort to tabulate its growth.

★ ★ ★

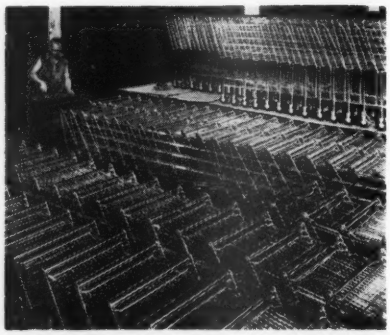
Formed wire products are not entirely new. Perhaps they began with the first coat hangers, bustles, or wire-backed chairs. But since World War II, the myriad uses produced by creative designers have opened broad new horizons. Today, one will find steel wire going into such diverse products as utility containers, modern furniture, letter holders, wall decorations and outdoor grilles.

★ ★ ★

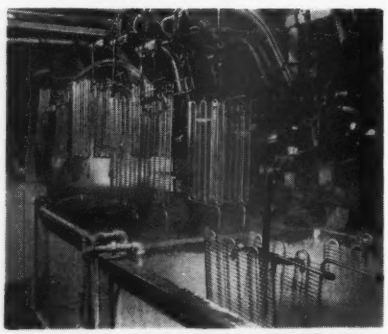
To grasp quickly the size of this new dimension, consider the growth of one of the nation's leading producers of formed wire products—**United Steel and Wire Company** of Battle Creek, Michigan. Since the end of World War II, it has nearly doubled the size and scope of its operations.

★ ★ ★

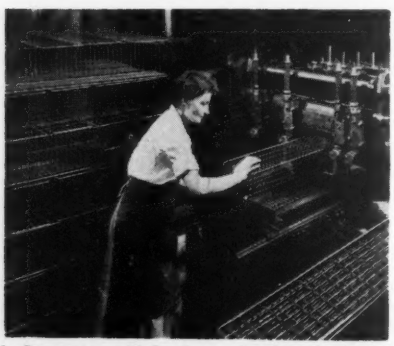
In one year, United produces some 4,500,000 shelves for commercial refrigerators, 900,000 milk crates and ice cream hardening cases, 750,000 baskets of various types, 100,000 shopping carriers and additional hundreds of thousands of point-of-sale display stands, outdoor grilles, beverage cases, dish racks, and bird cages. To make these products, United uses about 15,000 tons of wire annually, a large share of which is supplied by our company.



1. The grocery carrier you use at supermarket or grocery, made of welded steel wire, may have come from United Steel and Wire Company, where a variety of models are produced at a 500-a-day clip. Finish must be extra smooth to prevent torn packages. * * * * * * * * *



2. Home freezer shelves are given a bright chrome finish on this automatic plating line. Steel must be extra clean and smooth, as plating will magnify even the slightest surface imperfections. *



3. Ice cream will be frozen in these hardening cases. Once welded, the wire is galvanized to protect against corrosion. United holds forms and jigs for 400 special sizes. * * * * * *

★ ★ ★

Structural advantages of formed wire products include strength and rigidity with light weight. Wire construction provides for self cleaning and permits air or liquid circulation. A staff of engineers is busily designing new products or changing existing designs to make them more efficient and to lower costs.

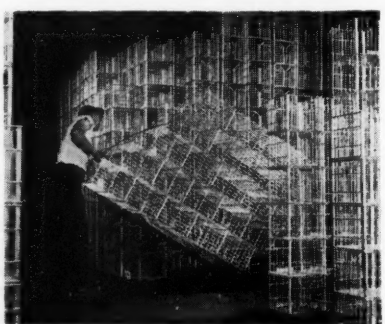
Importance of Quality

The steel wire that goes into these products ranges in sizes from nearly ½ inch in diameter to less than 1/10 of an inch. It has to be strong, yet ductile enough for forming and easy welding on intricate automatic multiple welding machines. It has to have an extra-smooth and clean surface to make possible good chrome and nickel plating, of galvanizing or painting, so as to permit of attractive, yet durable finishes.

★ ★ ★

United relies on wire makers with long know-how to produce this wire. As one of United's important suppliers, with more than 50 years experience in wire making in a range that includes everything from large diameter basic bright wire to fine specialty wires as small in diameter as a human hair, it has been our privilege to work with them in the development of new and better wire products.

(*Please turn to page* 1371)



4. Your milkman may deliver your milk on one of these wire bottle crates made by United at a rate of 3,000 daily. Sturdily built, yet light in weight, they have self-cleaning features. * * *

Government Wire Production Information

Additional Titanium Production Assured

Signing of a contract which calls for construction of a $31,500,000 plant designed to produce 7,500 tons of titanium annually was announced recently by the **General Services Administration.**

★ ★ ★

The contractor is **Union Carbide and Carbon Corporation,** of New York, which will act through its Division, the **Electro Metallurgical Company.**

★ ★ ★

Edmund F. Mansure, Administrator of General Services, said the agreement provides that Electro Metallurgical Company will use its own funds for the design, construction and equipping of the facility. The new plant is to be located at or near Ashtabula, Ohio.

★ ★ ★

The facility will be in operation within two years. Then, within the following twelve months it will attain a commercial rate of production, 500 tons a calendar month. Thereafter, the Government has an option to buy 4,500 tons annually at the market price prevailing at time of delivery. In addition, the company has the right to deliver to the Government whatever production it cannot sell in the commercial market, up to a maximum of 6,000 tons per year.

★ ★ ★

The agreement runs for a five-year period, from the time the plant starts producing in commercial quantities. However, upon one year's notice the Government may cancel the agreement by paying the company an amount equal to the unamortized cost of the plant.

★ ★ ★

The new plant will be the first commercial facility to employ a method other than the well-known Kroll process, which is used in other production. Electro Metallurgical has pioneered a sodium reduction method, which it has had in pilot and prototype stages for some time.

★ ★ ★

In addition to an experimental type contract, with **Horizons Titanium Corporation,** and a lease with Western Pyromet Company, GSA said this announcement brings total planned titanium capacity to 22,500 tons per year.

★ ★ ★

Other contracts in effect are: **DuPont,** 2,700 tons annually; **Titanium Metals Corporation of America,** 3,600 tons annually; **Cramet, Inc.,** 6,000 tons annually; **Dow Chemical Company,** 1,800 tons annually. The DuPont Company is al-

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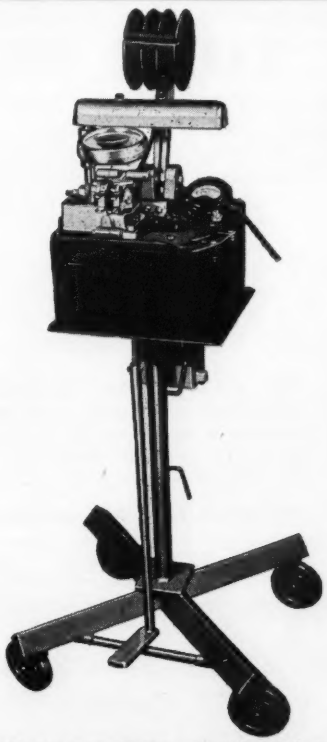
Unit design of frame, transformer and power sub-assemblies permit other range of sizes to suit requirements.

Equipped with a temperature indicating annealing and tempering device, voltage regulator and meter to compensate for voltage fluctuation, wire cutters, extra large 5" diameter magnifying glass, fluorescent light and extension cord. Welder can be supplied for bench mounting, or mounted on 4-wheel truck.

The adaptability of this unit for welding all types of wire, either ferrous or non-ferrous, in sizes from .005" to .020" diameter, makes it ideal for the fine wire manufacturer.



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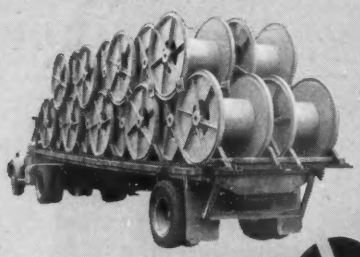

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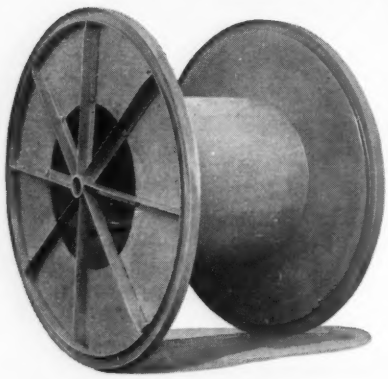

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★ ★ ★

Titanium is described as the "wonder metal" because of its qualities of strength and corrosion resistance coupled with relatively light weight. Alloys have been developed which are stronger than many present steels and are 40 per cent lighter. The metal has important applications in the production of aircraft.

ABSTRACTS

WIRE DRAWING

NEW INSTRUMENT SIMPLIFIES DIAMOND DIE INSPECTION.
M. Davies (BISRA). Iron Age 1954 Vol 173 (23) pp 130-132 (June 10).

Account of BISRA die profiloscope; see Bibl Ind Diamond Appl 1954 Vol 11 p 201 (July). 6 illustr.

Y **D 11.0 : D 15.2**

★ ★ ★

ZIEHEISEN ZUM METALL- UND DRAHTZIEHEN. WIRE DRAWING DIES.
M. G. De Smet. Pratique des Ind Mêcan 1954 (1) pp 16-22; Fertigungstechnik 1954 Vol 4 (7) insert pp (July) (In German; original in French).

Description of drawing machine and dies below 2 mm dia, small diamond drawing die set in bronze being used. Stated that diamond drawing dies are very sensitive, and can, owing to physical heterogeneity, break occasionally under stresses of drawing process. Ref also to drawing dies of sintered carbide (wrongly translated as Metallkohle).

G **C 11.0**

★ ★ ★

INFLUENCE OF THE ADSORPTION OF GAS ON THE MECHANICAL STRENGTH OF A METALLIC WIRE.
H. Forestier, A. Claus. Comptes Rendus (Paris) 1954 Vol 238 (2) pp 207-209; Inst Met Journ Metall Abstr 1954 Vol 21 (10) col 856 (June) (Original in French).

Y **C 11.0**

★ ★ ★

DESIGN AND CONSTRUCTIVE OF NICKEL THERMOCOUPLES.
W. G. Rauch. Met Progr 1954 Vol 65 pp 71-74 (Mar.); Nickel Bull 1954 Vol 27 (5) p 80 (May).

Needle-type thermocouples have insulated wire as one component, inserted in tube as 2nd component; can be made very small in dia by using hypodermic needle tubing with fine wire insert.

Y **C 11.0**

★ ★ ★

COLD DRAWING OF THORIUM WIRE.
H. A. Saller, J. R. Keeler, R. J. Donley, C. D. Graham. US Atomic Energy Comm Publ BMI-704 1951 6 pp; Inst Met Journ Metall Abstr 1954 Vol 21 (10) col 903 (June).

To overcome tendency for Th wire to seize in dies during cold drawing, study made of drawing lubricants suitable for this metal.

Y **C 11.0**

★ ★ ★

SINTERED CARBIDE DIE POLISHING MACHINE.
J. Urbanek & Co., Frankfurt/M. Ind Diamond Rev 1954 Vol 14 (165) p 175 (Aug).

New machine, intended for die from 0.3 to 10 mm, for drilling and polishing reduction cone, polishing and calibrating bearing and rounding off shape. Spindle speed 16,000 rpm, needle reciprocations at rate of 1,000 per min. Small attachment for grinding conical needles.
G D 11.0

NOTICE

These abstracts are furnished through the courtesy of the Industrial Diamond Information Bureau, 32 Holborn Viaduct, London, ECI, Eng. Requests for further information should be directed to the Bureau.

"Strength and Resistance of Metals"

This new book, written by **John M. Lessells,** President of Lessells & Associates, Inc., Boston, and Emeritus Associate Professor of Mechanical Engineering at M. I. T., is intended to provide design engineers with information on the behavior of metals under stress, particularly with reference to machine components.

★ ★ ★

Material comprises the author's own information and that of numerous other workers in the field of mechanical engineering. Most of the discussion centers around steel, but non-ferrous alloys and cast iron are also discussed in relation to steel.

★ ★ ★

Such subjects as tensile tests, stress-strain characteristics, overstrain mechanisms resulting from cold drawing, hysteresis effects, rupture and creep tests, hardness, impact, engineering failures, influence on fatigue from temperature, size, form and surface condition, mechanical wear, working stresses and other related subjects.

★ ★ ★

From theory and experience, based on experiment and practice, the author hopes his book will contribute to more reliable and economical designs. A number of illustrative problems are included.

★ ★ ★

The book contains 450 pages of text, charts, illustrations and formulae and sells for $10.00. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.

Licensed manufacturers of recessed head screws who have specified "Special Processed" wire for their difficult cold heading jobs find that it more than pays for itself by: (1) increasing the production rate which *lowers the cost per unit*; (2) greatly prolong die life which *reduces machine down-time and labor costs*; (3) providing a higher quality finished product which *minimizes rejections and inspections.*

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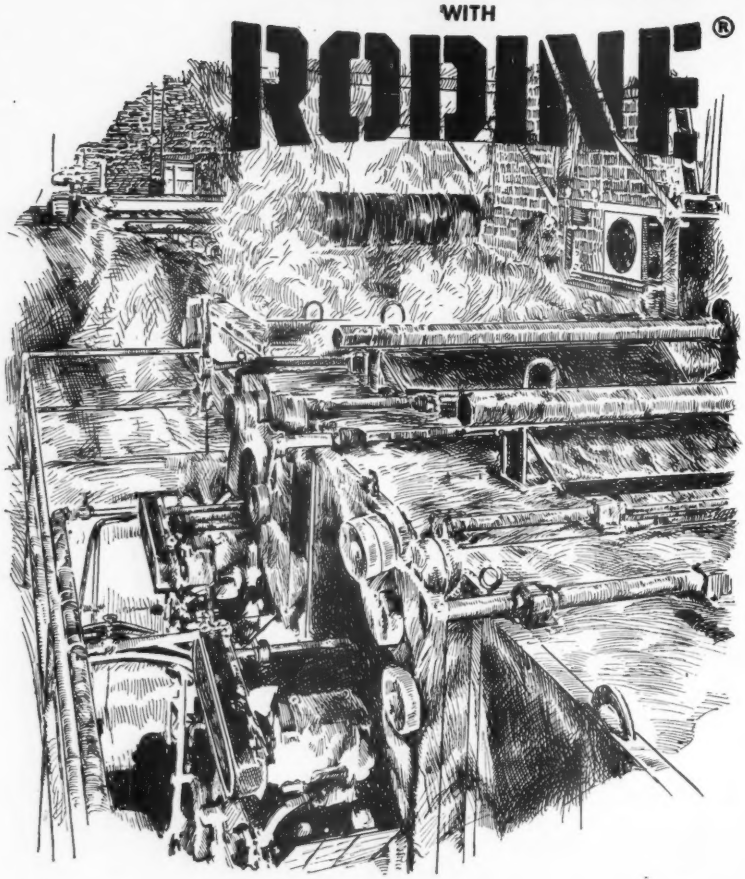

Rod and wire are pickled clean with "Rodine" without wasting either acid or metal. Breakage in drawing from acid brittleness is minimized.

It is cheaper to pickle with "Rodine" than without it.

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Pennsylvania Turnpike Resurfacing Using Welded Wire Fabric

The resurfacing of 22 miles of the Pennsylvania Turnpike with asphaltic concrete reinforced with steel welded wire fabric is now in progress. The topping project is the largest single repair job ever let by the Turnpike Commission, and largest use yet for the increasingly employed fabric-in-asphalt process.

★ ★ ★

The 22 mile stretch of the pioneer super highway between Laurel Hill Tunnel on the west and Allegheny Tunnel on the east centers on Somerset, Pa., and is probably the single heaviest travelled sector of the 'pike, funneling traffic through the mountainous heart of Pennsylvania. Part of the original 'pike built in 1940 without a prepared sub-grade, foundation, or today's improved draining methods, the reinforced portland cement concrete pavement has held up exceedingly well despite exceptionally heavy traffic.

★ ★ ★

Original thought of the Turnpike Commissioners in specifying welded wire fabric was to use the steel mesh only over the joints and cracks and utilize its ability to prevent formation of reflection cracks in the new surfacing. Numerous other applications in past years had indicated the effectiveness of fabric in minimizing or preventing such cracking, the bugaboo of many asphalt jobs.

★ ★ ★

It was decided, however, to employ welded wire fabric continuously, rather than just at the transverse joints. This continuous use of fabric, in addition to controlling cracking of the asphaltic surface, helps to prevent "rippling" and "shoving" of the asphalt.

★ ★ ★

First, the portland cement concrete pavement slabs of the original turnpike are cleaned and joint-sealing cut back to level. Second, workers lay the sheets of welded wire fabric, 11½ feet wide and 7 feet long, out ahead of the paver, and

lap and fasten them. Hog rings are used for fastening and are slipped over the longitudinal wires of the fabric, thus allowing the sheets to move as the hot mix causes expansion. Third, two pavers operating in tandem equipped with "hold-down" devices to prevent the fabric from entangling in the spreader, lay a two inch thick compacted course of binder material across the entire 24 foot lane width, over the welded wire fabric. A three-wheel, ten ton roller does the initial compaction, followed by two two-wheel rollers which do diagonal and cross rolling farther back.

"The Manufacture and Properties of Steel Wire"

This book by the late **Prof. Dr. Ing. Anton Pomp,** has been translated from the German by **C. P. Bernhoeft,** Dipl. Ing., F. I. M., M. I. M. The English edition was published this year by **The Wire Industry Ltd.,** London, England.

★ ★ ★

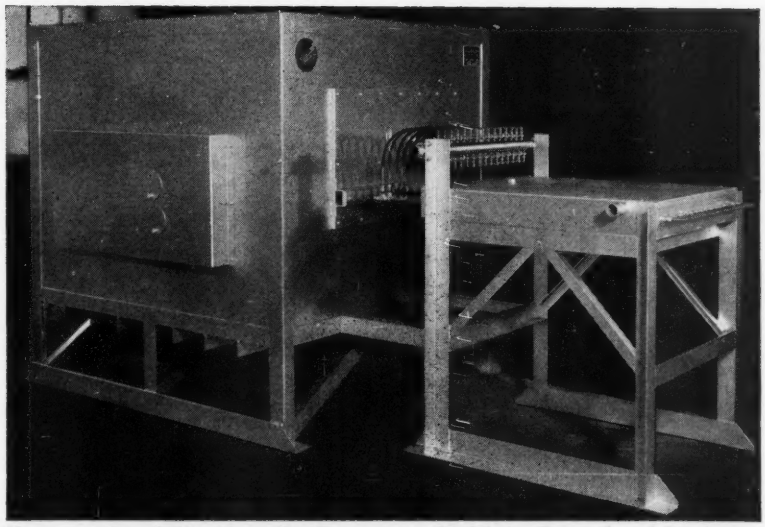
It covers all phases of steel wire manufacture, including mechanical descaling, increased wire drawing speeds, the latest developments in wire drawing lubricants, the shape of dies and instruments for checking them and other recent developments. This English edition includes an appendix in the form of illustrations in plants of British wire making equipment.

★ ★ ★

Various chapters include such subjects as the history of the development of the iron and steel industry, the raw material (rods), the finished product, preparation of wire for drawing, fundamentals of wire drawing, alteration of properties through drawing, installations for wire drawing, lubricants, annealing, patenting, hardening and tempering, straightening and cutting, grinding and polishing, flat wire rolling, galvanizing and tinning, dies, and testing.

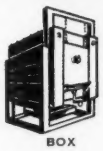
★ ★ ★

Each subject is, of course, broken down into many subdivisions. The book contains 358 pages of text and is liberally illustrated and sells for $11.80. It may be ordered through Wire and Wire Products, 453 Main St., Stamford, Conn.

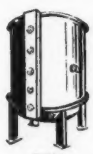


Harper 30 Strand Wire Annealing Furnace . . . Models for Research and Continuous Production

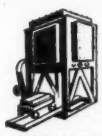
Bright Annealing by the Mile Saving Time, Cutting Costs for Mills and Fabricators



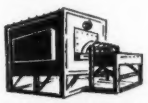
BOX



BELL



ELEVATOR

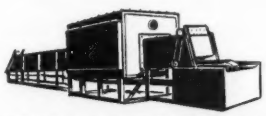


STRAND ANNEALING

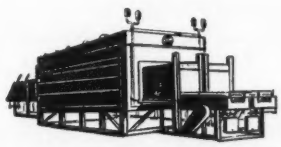
Growing uses of stainless steel and non-ferrous wire and strip has created new annealing and cleaning problems for operators and their customers.

The specialized design of Harper bright annealing furnaces is making it possible for wire mills to produce uniform products ready for spooling and fabrication. Expensive cleaning operations are eliminated . . . man-hour costs are cut . . . floor space is saved.

Write for full information on automatic, continuous production Harper bright annealing furnaces for Wire and Strip.



CONTINUOUS MESH BELT CONVEYOR



TWIN AND SINGLE MUFFLE PUSHER

Furnace Builders Harper *for over 30 Years*

Representatives in Principal Cities

HARPER
Electric Furnace Corp.
42 RIVER ST., BUFFALO 2, N. Y.

Then there was the man who married because he was lonely. Now he finds himself still lonely, only with sound effects.

Sometimes we think that maybe we get too voluble when the subject is XLO Music Wire; but, on the other hand, we look upon it as a duty to set forth honestly the qualities you can expect to find in this high quality product. Johnson XLO Music Wire is made by specialists in a specialty wire mill. No better music wire has ever been made by anyone. We could make it stronger, but are not voluble enough for that.

JOHNSON STEEL AND WIRE COMPANY, INC.

WORCESTER 1, MASS.

New York Philadelphia Pittsburgh Cleveland Detroit Akron
Dayton Chicago Atlanta Houston Tulsa Los Angeles

A SUBSIDIARY OF PITTSBURGH STEEL COMPANY

"The Insulation of Electrical Equipment"

This new book, published by **John Wiley & Sons, Inc.,** 440 Fourth Ave., New York, N. Y., has been edited by **Willis Jackson,** D. Sc., D. Phil., M. I. E. E., F. R. S. It is a compilation of the lectures delivered at a post-graduate course given in the Electrical Engineering Department of Imperial College in London in 1952.

★ ★ ★

The various chapters deal with the problems of insulation from several different aspects, each largely independent of the other. The eleven authors whose lectures are embodied in the book are each outstanding authorities.

★ ★ ★

Subjects include a historical survey of the development of electrical insulation, the properties of insulation materials, permittivity and dielectric loss, dielectric breakdown, classification of insulating materials, communication components, power cables and capacitors, electrical machines, power transformers, switchgear insulation and insulation testing in laboratory, plant and field.

★ ★ ★

The book embodies the results of a great deal of scientific research, both mathematical and experimental, but certain aspects of the work is expressed in non-mathematical terms. The aim of Dr. Wilson has been to clarify some fundamental phenomena and isolate them from extraneous effects, concentrating on the simplest possible systems that exhibit them.

★ ★ ★

The work contains 340 pages of text, charts, tables and illustrations and costs $7.75 per copy.

New Book on Solvents and Plasticizers

Arthur K. Doolittle's definitive work, "The Technology of Solvents and Plasticizers" was published in September by **John Wiley & Sons,** 440 Fourth Ave., New York 16, N. Y. The author's thorough explora-

tion into the principal fields where these agents are employed marks his new book as a reference for those working with paints, varnishes, lacquers, adhesives, inks, synthetic textiles, and plastics.

★ ★ ★

Years of research and preparation lie behind Mr. Doolittle's decision to combine the theoretical and technological aspects of the subject. In the technical sections, he has emphasized the behavior of the systems studied over a range of the variables, rather than on specific formulations. The formulator is thereby provided with a scientific basis for deciding on the appropriate composition for a specific purpose. In the theoretical parts of the book, the theories of solvent action and viscosity are handled. The author also includes complete chapters on the recovery, handling, storage, and shipping of the raw and finished products.

★ ★ ★

A breakdown of chapters carries such headings as Technology of Solvents for Resinous Substances, Nitrocellulose Lacquers, Vinyl Resin Coatings, Technology of Application, Solvents for Textile Fibers, Solvents for Adhesives, and The Viscosity of Liquids. These and others include, both individually and classified by groups in tabulations and charts, the complete physical and chemical data on the 161 solvents and 131 plasticizers now commercially available.

★ ★ ★

Mr. Doolittle, assistant director of research with the Carbide and Carbon Chemical Company, has been affiliated with the firm since 1932. In addition to contributing specialized chapters to various full-scale books, he is the author of numerous technical papers, and holds thirty patents, mostly in solvents, plasticizers, resins, and surface coatings.

★ ★ ★

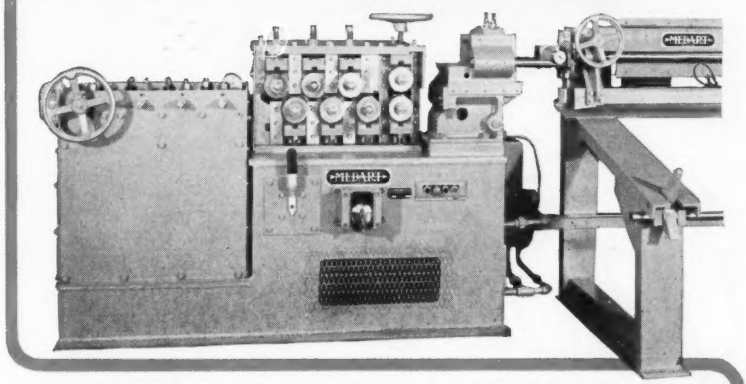
"The Technology of Solvents and Plasticizers," a 1056-page book, is priced at $18.50.

Join The WIRE ASSOCIATION and work with others to improve the industry. Send for booklet.

Straighten Shaped Wire Automatically At Speeds Up To 250 FPM!

MEDART

Supermatic SHAPED WIRE STRAIGHTENER AND CUTOFF MACHINE



- Only machine of its type. Equipped with infinitely variable all-hydraulic drive. Throughput speeds adjustable from 100 to 225 f.p.m. with intermittent duty at 250 f.p.m.
- Hydraulic drive can be started or stopped instantly. Design of hydraulic circuits permits machine to be changed instantaneously from full speed forward to full speed reverse.
- Full automatic feed-through, straightening and cut-off, without attention from operator, after end of coil is started through pinch rolls.
- Hydraulic shear is completely automatic in operation, and is actuated by electric length-of-cut control adjustable for any predetermined cutoff length. Eliminates all swelling or expansion of workpiece. Machine can deliver a finished 12-ft. long piece of wire from coil every 3¼ seconds.
- All adjustments are made by fine pitch screws. All rolls in straightening section are adjustable to insure proper centerline pass of each shape of wire.

Write For Details

Supermatics for round wire 1/16" to 1" also available

THE MEDART COMPANY 3535 DE KALB STREET ST. LOUIS 18, MO.

Outstanding Personalities of the Wire Industry

Made Sales-Production Coordinator

Appointment of **James C. Westfall** as manager of sales-production coordination, Mechanical Goods Division, **United States Rubber Co.**, has been announced by **Ernest G. Brown,** vice president and division general manager.

★ ★ ★

It will be Mr. Westfall's job to develop programs and schedules to facilitate customer service and maintain continuous production with reasonable inventory investment. He will work with sales management, production management and factory sales production coordination managers, and will be headquartered in the company's Passaic, N. J., plant. He is a graduate of Princeton and the Harvard University School of Business Administration.

Appointed Sales Manager by Apex Alkali

Apex Alkali Products Co., Philadelphia 27, Pa., has announced the appointment of **William B. Bauzenberger** to the position of Sales Manager.

William B. Bauzenberger

★ ★ ★

Bill has been with Apex Alkali since 1943. In 1949 he was made Sales Manager of Western Pennsylvania, Ohio and Indiana, at which time he had headquarters in Pittsburgh.

★ ★ ★

He has moved his residence to Wayne, Pa., a suburb of Philadelphia, and in his new capacity he will function as sales manager for all territories served by the company.

Made General Manager of Chase Unit

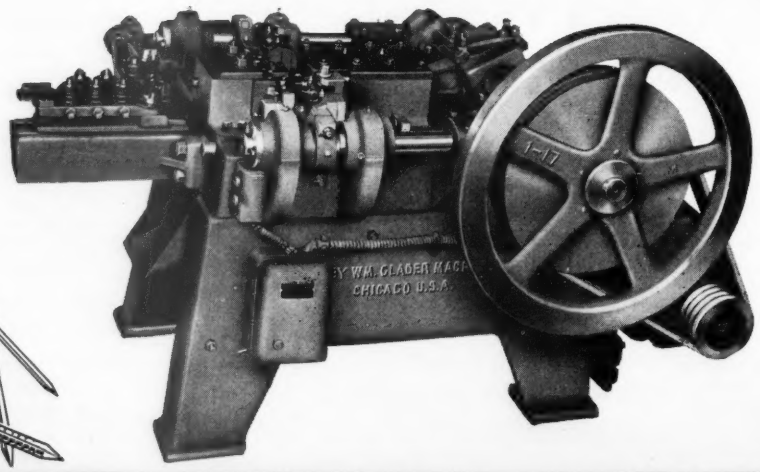
Richard C. Diehl, president of **Chase Brass & Copper Co.,** subsidiary of **Kennecott Copper Corporation,** has announced the appoint-

Glader—Years of Proven Performance

GLADER NAIL MACHINES

55 YEARS of experience meeting the exacting demands of nail making.

The machine with a record of steady dependable service.



Wm. GLADER MACHINE WORKS 210 N. RACINE AVENUE CHICAGO 7, ILLINOIS

Export Dept: 122 East 42nd Street, New York 17, N. Y.

ment of **J. Walter Gulliksen,** of Worcester, Mass., as general manager of the **Waterbury Manufacturing Company.**

★ ★ ★

Mr. Gulliksen, in his new position, will be generally responsible for production, which is in direct charge of **Norman A. Greist** as factory manager, as well as for sales, which is in direct charge of **J. Walter McGarry** as sales manager of the Waterbury Manufacturing Company.

★ ★ ★

Mr. Gulliksen is a graduate engineer from Stevens Institute of Technology with a degree in Mechanical Engineering. He has also completed post graduate work at New York University, Rutgers Extension University, Stevens Institute and Worcester Polytechnic Institute, in many subjects, including commercial law, industrial personnel management, metallurgy and powder metallurgy.

★ ★ ★

He served 15 years in various capacities with the **Aluminum Company of America,** including 2 years as factory superintendent of the Aluminum Index Company. In 1942 he joined the **Worcester Pressed Steel Company,** as assistant to the general manager. In 1946 he was made general superintendent and soon thereafter was made a director. Later he was promoted to factory manager, which position he held until recently.

A.S.T.M. Honors Sam Tour

At the 57th Annual Meeting of the **American Society for Testing Materials, Sam Tour,** President of **Sam Tour & Co., Inc.,** was honored by an Award of Merit "for long and fruitful service to the Society extending over many technical fields and administrative phases, for work on test methods, and especially for contributions to the metals and corrosion fields."

★ ★ ★

Mr. Tour's participation in ASTM's activities started 33 years ago. During these years he has become well known for his contributions on testing machines and on impact, stiffness, salt spray and corrosion testing.

★ ★ ★

A member of 14 different technical committees and 35 different sub-committees in this time, Mr. Tour has served as Chairman for ten years of Committee B-7 on Aluminum and as Chairman for four years of Committee B-3 on Corrosion of Non-Ferrous Metals. In addition, for eighteen years he was secretary of the latter. He has served as an elected Director of the Society for three years.

Mr. Tour maintains his Research and Testing Laboratories at 44 Trinity Place, New York City.

Made Production Manager by Timkin

Robert W. Ertle has been named Superintendent of Production, Canton Bearing factory, by **The Timken Roller Bearing Co.,** and **Kenneth R. Adair** has been promoted to Superintendent, Maintenance of the Canton and Gambrinus bearing factories.

Standardize on ACROPAK* Spools!

Only ½ the Weight!

Light Weight
Precision built
Reduced cost
Longer life
Extra strength
Dynamic balance
Greater production
Low cost reconditioning
Less maintenance
Attractive packaging

YET STRONG, TOUGH, RIGID . . *LONGER LIFE*

ACROPAK Spools will help you cut wire packaging costs because they give longer service, require less maintenance and cost less to ship. They're strong. They'll take repeated shippings and still run true on the arbor. They're machined to close tolerances. You can run them at high production speeds with fewer snags, less toe-out and minimum end breakage.

THEY CUT YOUR SPOOLING COSTS

Best proof of ACROPAK superior performance are the millions of these spools now used by the biggest names in the wire industry. We've proved it to them—let us prove it to YOU.

★ We also make a complete line of heavy-duty shop processing STEEL SPOOLS built to the same high standards of accuracy and rigidity as the famous Acropak aluminum spools.

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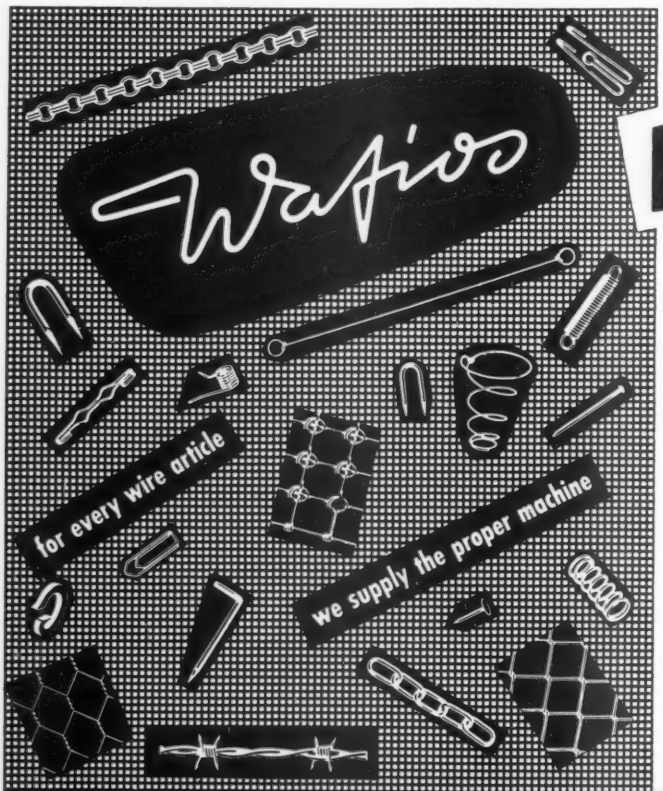
CAMDEN WIRE CO., INC.

Wire Fabricators

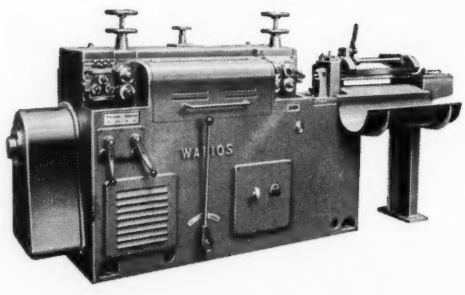
MANUFACTURERS OF BARE, TINNED AND SILVER PLATED STRANDED COPPER WIRE, CONCENTRIC OR BUNCHED

40 Masonic Avenue • Camden, New York



AUTOMATICS

FOR THE WIRE TRADE



HIGH SPEED WIRE NAIL PRESS
9 different sizes. Wire diam. range: SWG 22-3
Length of nails: ¼-12″

Sole Agents: Kurt Orban Co., Inc.
205 E. 42nd St., New York 17, N. Y.
Telephone: Murray Hill 4-7700. Cables: ORBONOK, N. Y.

WAFIOS MASCHINENFABRIK REUTLINGEN 3 / GERMANY

Named Section Head by International Nickel

The appointment of **Walter H. Prine** as head of the Electroplating-Chemical-Catalyst Section of the Nickel Sales Department has been announced by **The International Nickel Company, Inc.,** New York. He will handle commercial relations with distributors and users of nickel for electroplating, for chemical manufacturers and for catalysts.

★ ★ ★

Mr. Prine joined International Nickel in 1945 as a member of the Plating Section of the Sales Department, working in liason between the company's research laboratory and the plating field in the development of new uses and the extension of prevailing uses of nickel in this field.

★ ★ ★

Prior to his association with Inco, Mr. Prine served for seven years with the Lamp Division of Electric Auto-Lite Corporation as Chief Chemist in charge of metal finishing and metallurgical processes.

★ ★ ★

A native of Cincinnati, Mr. Prine graduated from the University of Cincinnati Engineering College in 1938 with the degree of Chemical Engineer and in 1945 he received the degree of Bachelor of Science in Commerce from the University of Cincinnati Evening College. He is the author of a number of technical papers dealing with nickel plating.

Pacific Coast Borax Transfers Technical Service Man to East

The Pacific Coast Borax Co., Division of **Borax Consolidated, Limited,** New York, has recently moved **Grover G. Collins** to their Eastern Sales Office, where he will assist in the Technical Service and Product Development work for the company's Industrial Division. Mr. Collins received a B. S. Degree in Chemical Engineering from the University of Alabama in 1943 and has for the past eight years worked in the company's Research Laboratory.

To Represent Acrometal Products in Midwest

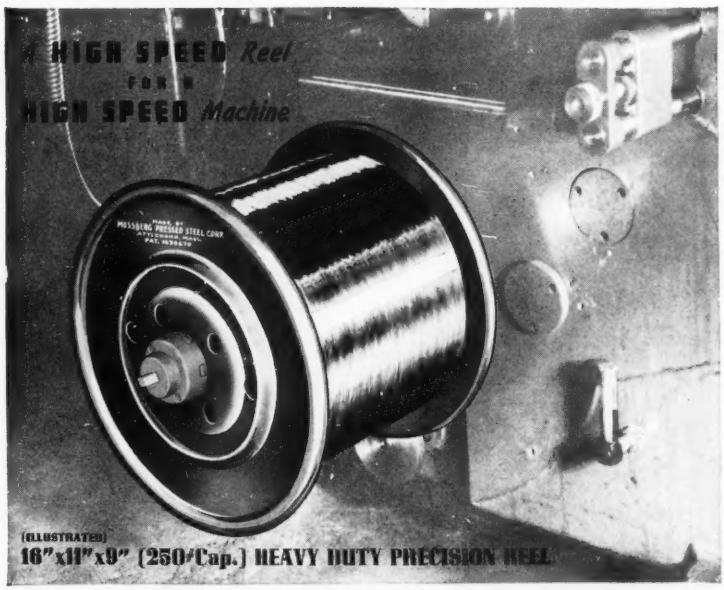
Fred J. Bieber, general manager of **Acrometal Products, Inc.,** Minneapolis, has announced that **Thomas R. Polglase** has been appointed mid-western sales representative for Acrometal.

★ ★ ★

Mr. Polglase has been purchasing agent for **Anaconda Wire & Cable Company's** Muskegon Michigan mill since 1949, and is a past president of the Western Michigan Purchasing Agents Association. He brings to Acrometal Products a wealth of experience with Acropak spools used in packaging magnet wire.

★ ★ ★

He has a wide acquaintance in the wire and cable industry and has had national recognition for his invention of a molded shipping case for magnet wire, now an Anaconda standard, having won the "Package of the Year" Award at the 1952 convention of the Society



Mossberg PRESSED STEEL Corporation

offers: **BALANCED PRECISION REELS in HEAVY DUTY construction for use on modern HIGH SPEED wire drawing machines.**

To provide higher operating efficiency, with the ever increasing tendency towards the drawing of finer gauge wire on larger reels at higher speeds, the following reel requirements are now essential:

BALANCE — DURABILITY — STRENGTH — AC CURACY
PROPER PROPORTION

All these requirements are incorporated in spools and reels made by

Mossberg PRESSED STEEL Corporation

18 WEST STREET ATTLEBORO, MASS., U. S. A.
TELEPHONE ATTLEBORO 1-0848 No. 101

of Industrial Packaging and Materials Handling Engineers, of which he is a member.

★ ★ ★

He recently served as chairman of the N.E.M.A. Committee on Development of a Standard Pallet for Shipment of Magnet Wire.

★ ★ ★

Tom will cover the central United States industrial area for Acrometal, continuing to make his home in Spring Lake, Michigan, and handling Acropaks for both the Wire and Textile trades.

★ ★ ★

Harrison Lane, present Eastern sales representative and well-known in the East, will continue to represent Acrometal in the East.

English Wire Man Visits Australia

Lieut.-Commander G. K. Rylands, O.B.E., R.N., managing director of **Rylands Brothers, Ltd.**, of Warrington, England, and a director of **The Lancashire Steel Corporation**, recently paid a visit to Australia.

★ ★ ★

An inspection of Newcastle's industries was included in Lieut.-Commander Rylands' itinerary, and he was particularly interested in his tour of the **Rylands Bros. (Aust.) Pty. Ltd.** Wire Mills.

★ ★ ★

Lieut.-Commander Rylands was the guest of honour at a luncheon tendered by the management at the Wire Mills. **Frank Jenks**, Wire Mills manager, was chairman of the function at which more than 70 members of the staff were present.

★ ★ ★

In the course of an interesting address Lieut.-Commander Rylands gave a resume of the development of the wire industry since the establishment of the Newcastle Wire Mills. He drew attention to the fact that although the Warrington and the Newcastle Mills had tackled many of their problems in different ways, satisfactory solutions had been achieved.

★ ★ ★

J. K. MacDougall, formerly manager of the Newcastle Wire Mills, and now a consultant to the company, spoke of the guest's high stature in the steel industry and of his own happy association with him over a number of years.

★ ★ ★

M. Howarth, formerly assistant manager of the Newcastle Wire Mills, said that many employees of Rylands' Newcastle Wire Mills, including himself and Mr. Jenks, had come originally from Rylands' Warrington plant. He believed that they could say with all modesty that they had made a useful contribution towards the successful establishment of the Australian steel wire industry.

Firth Sterling Elects New Director

Kenneth D. Mann, President of **Firth Sterling Inc.**, announces the retirement of **A. C. Wickman** of Toronto, Canada, as a director of the company. **D. Dean McCormick**, senior partner of **McCormick & Co.**, Chicago, was elected to succeed Mr. Wickman.

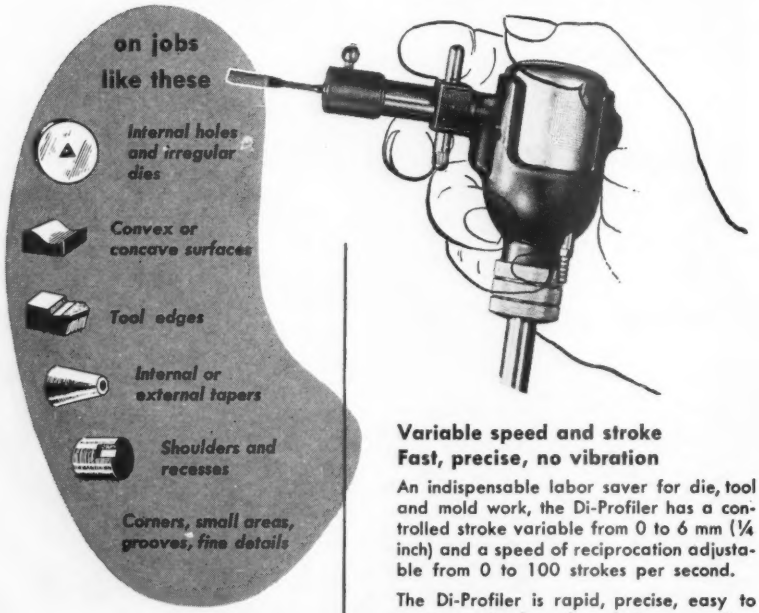
★ ★ ★

Mr. Wickman was the former President of A. C. Wickman, Ltd., Coventry, England, and recently chairman of A. C. Wickman, Canada, Ltd.

THE **Di-Profiler**

RECIPROCATING HAND MACHINE

for time-saving cutting—roughing—finishing


on jobs like these
Internal holes and irregular dies
Convex or concave surfaces
Tool edges
Internal or external tapers
Shoulders and recesses
Corners, small areas, grooves, fine details

Variable speed and stroke
Fast, precise, no vibration

An indispensable labor saver for die, tool and mold work, the Di-Profiler has a controlled stroke variable from 0 to 6 mm (¼ inch) and a speed of reciprocation adjustable from 0 to 100 strokes per second.

The Di-Profiler is rapid, precise, easy to operate—simple and sturdy in construction. Its weight of less than one pound and freedom from vibration eliminate fatigue and assure perfect control for the most intricate work.

Moderately priced, the Di-Profiler pays for itself many times through time-saving cost reductions.

Write for free demonstration or illustrated price list DW-1154

Tools for every type of work
CUTTERS, FILES, DISCS, POINTS, BURRS, LAPS, SCRAPERS

ENGIS EQUIPMENT COMPANY
Sole Authorized Distributor for the United States
431 S. Dearborn Street, Chicago 5, Illinois

Honeywell Announces Nine Transfers in Field Force

Appointment of new managers in five cities and reassignment of four key sales engineers is announced by **Gavin S. Younkin,** general sales manager of **Minneapolis-Honeywell Regulator Company.**

★ ★ ★

F. M. Thuney, former Washington, D. C. branch manager, has been promoted to manager of the contract division in Honeywell's Industrial Division plant at Philadelphia, while **J. W. Bowers,** former Grand Rapids, Mich. manager, has been named to head a newly-created department of service and repair of controls for commercial establishments in Minneapolis.

★ ★ ★

Harry E. Grossman replaces Mr. Thuney as manager of Honeywell's Washington branch and **Joseph H. Nixon** will head the firm's Grand Rapids district office. Mr. Grossman was formerly manager of the company's Harrisburg, Pa.' office while Mr. Nixon was previously senior commercial salesman in Saginaw, Mich.

★ ★ ★

Other new managers named include **Wayne F. Kelley** who replaces **George Dieter** as manager of the Spokane, Wash. branch; **T. S. Bolling,** assigned to the Charleston, W. Va. district office and **Charles W. Prey** named to head the Harrisburg district office.

★ ★ ★

Additional field assignments announced include **Leight M. Johnson,** former senior commercial salesman in Philadelphia, to branch commercial sales manager in Harrisburg and **Raymond A. Metz,** former senior commercial salesman in Wilmington, Del. to a similar post in Philadelphia.

Carboloy Adds to Field Staff

Rudolf Torbico, formerly associated with Moore-Wright Co., Port Huron, Mich., and previously with Ford and General Motors, has joined the **Carboloy Department of General Electric Company,** as a field sales representative.

Mr. Torbico will make his home in Davenport, Iowa. He holds a B.S. degree in industrial management from the University of Akron.

Magnuson Adds Two Representatives

William F. Nickerson, Sales Manager of **Magnuson Products Corp.,** 50 Court St., Brooklyn 2, N. Y., has announced the appointment of two representatives.

★ ★ ★

Harry R. Johnson will serve the Chicago area from offices at 10017 So. Perry St., Chicago 28, and Wayne J. Streavig will be serving Philadelphia area and can be reached through the home office.

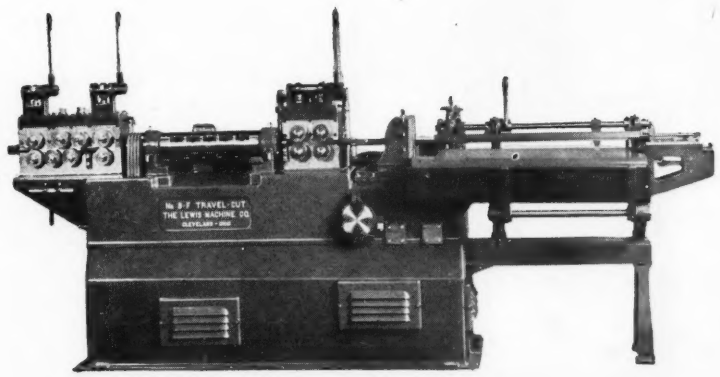
★ ★ ★

Both men have an industrial background and experience that fits them well for serving Magnuson customers. The company manufactures cleaning compounds, wire drawing lubricants and other specialized products.

Fast, Accurate, Economical

STRAIGHTENING and CUTTING

with LEWIS **TRAVEL-CUT**



22 Models to handle from .012" to ¾" Round, Hex, Flat, Shapes.

Simple in design, rigid in construction, Lewis TRAVEL-CUT will deliver continuous dependable service under the most severe, high production conditions—day in, day out. Feeds wire from the coil, straightens accurately, gauges to uniform length, and cuts clean without stopping the wire. For steel, brass, aluminum and alloy wire. Cut your cutting costs with the Lewis TRAVEL-CUT. Full details on request.

Exclusive Representatives

EAST: Penn Machinery Co., 117 North Third Street, Philadelphia 6, Penn.

MIDDLE WEST: Steel & Wire Machinery Co., 15457 Euclid Ave., Cleveland 12, O.

CENTRAL: Moslo Machinery Co., 2443 Prospect Avenue, Cleveland 15, Ohio.

WEST COAST: Hoffman & Heartt, 3005 So. Grand Ave., Los Angeles 7, California.

CANADIAN: Empire Engineering Co., 738 Dundas St., East, Toronto, Ont., Canada.

CONTINENTAL EUROPE: Gaston E. Marbaix Ltd., Devonshire House Vicarage Crescent, London S. W. 11, England.

The LEWIS MACHINE Company

3441 E. 76th Street, Cleveland 27, Ohio

Also agents in Paris, Stockholm, Rotterdam, Brussels, Zurich, Milan, Bombay and Melbourne

New Wire Mill for Columbia

William E. Boyer and **Richard C. Roeder** of Cleveland, Ohio, together with a group of business men in Bogota, Colombia, South America, are establishing and expect to have in operation by the first of the year a new wire mill in that city. The concern will draw wire and manufacture wire products.

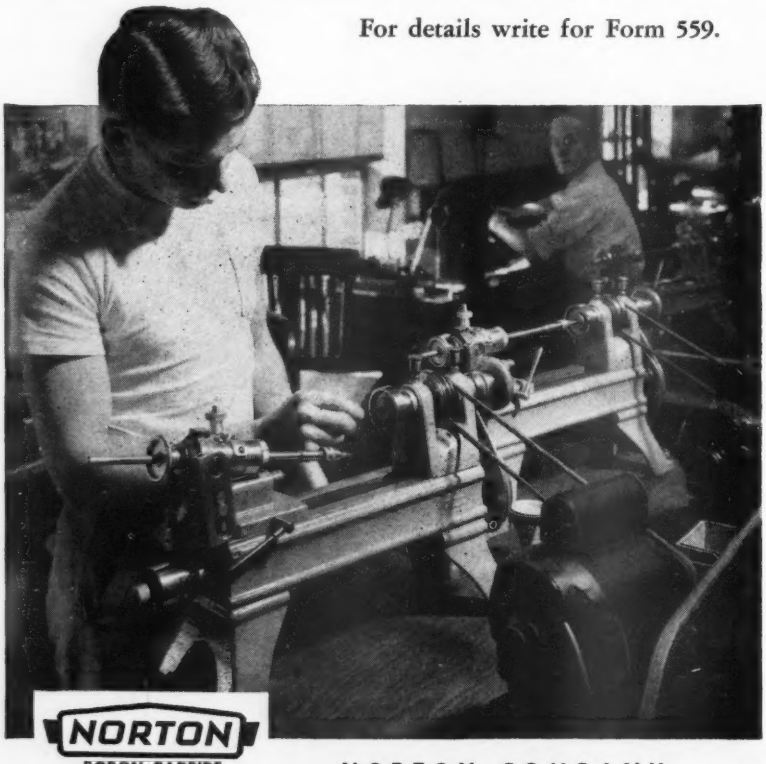
New York State Representative Appointed by Ajax Electric

Ajax Electric Co., Philadelphia, Pa., has appointed **A. C. Towne, Jr.**, Buffalo, as its upper New York state representative. Mr. Towne and his associate, **C. Percival Jr.**, also will represent Ajax in a few counties in northern Pennsylvania, including Erie.

Save Money with NORBIDE® Abrasive . . .

Are you still using costly diamond dust for refinishing your wire drawing dies? Many wire mills are saving money by using NORBIDE Abrasive for ripping or fast stock removal as well as for accurate semi-finishing operations.

For details write for Form 559.



NORTON BORON CARBIDE

NORTON COMPANY
45 New Bond Street • Worcester 6, Massachusetts

NORBIDE® . . . *the hardest man-made abrasive*

Hooker Adds Technical Men to Staff

Three technical men have recently been added to the staff of the research and development department of **Hooker Electrochemical Co.** at its Niagara Falls plant. They are **Lawrence E. O'Donnell,** chemical engineer, assigned to the plastics and resins group; **Dr. Raymond R. Hindersinn,** chemist, assigned to the chlorination research group; and **William J. Strachan,** chemist, assigned to the physical chemical section of the analytical group. The announcement was made by **Dr. Jack H. Bruun,** director of research and development.

Elected Director of Whitney Chain

B. G. Tyrrell, treasurer, has been elected to the board of directors of **Whitney Chain Company,** Hartford, Conn., it has been announced by **W. H. Whitney,** board chairman.

★ ★ ★

Mr. Tyrrell was formerly associated with Colt's Manufacturing Company, where he served as chief accountant from 1942 to 1944. After eight years with Whitney Chain he was elected treasurer.

Made Sales Engineer by Republic

E. L. McReynolds has been appointed a sales engineer for **Republic Steel Corporation's Union Drawn Steel Division, E. B. Files,** manager of sales, has announced he will be located at Union Drawn headquarters at Massillon, Ohio.

★ ★ ★

A graduate of Missouri School of Mines, Mr. McReynolds was employed as a metallurgist for Union Drawn from 1935 to 1945. Prior to his new appointment he was associated with the Sharon Steel Corp.

★ ★ ★

The world's largest producer of cold drawn steels, Union Drawn operates plants in Massillon, Beaver Falls, Pa., East Hartford, Conn., Gary, Ind. and Los Angeles, Calif. A Republic subsidiary, Union Drawn Steel Company, Ltd., is at Hamilton, Ontario, Canada.

Henry F. Hubbard

Henry Franklin Hubbard, 85, recognized as the "dean of American pinmakers" and inventor of the machine which produced the first "bobby pins," died on October 11th in East Hampton. He retired from active business in 1943 after 57 years of activity in the pin making business. His father was credited with building the first pin making machine in the United States.

★ ★ ★

Mr. Hubbard was born in Derby, Conn., September 18, 1869, a son of James C. and Helen (Shelton) Hubbard. He entered the pin-making industry at a plant established by his family in North Haven. It later became the **Star Pin Company** and its operations were moved to Shelton, Conn. Mr. Hubbard became a pin machine designer under the supervision of his father. The family name has been associated with pin making and pin machines for over a century.

Diamond Concern Moves Offices

The United States Industrial Diamond Corporation announced recently the moving of its offices to 589 Fifth Avenue, New York 17, N. Y. Sales management of the company is by **Diamond Distributors, Inc.** who have moved to the same address.

★ ★ ★

The company is a large supplier of industrial diamonds, but is better known to the wire industry as manufacturers of precisely graded, top-quality diamond powders, which they market under the trade-name "Diadust".

Firth Sterling Appoints Three New Distributors

In line with its policy of expanded distribution, **Firth Sterling Inc.** has appointed three new industrial distributors: two in its Southern district and one in its Detroit district.

★ ★ ★

The E. C. Blackstone Co. of Memphis, Tenn., and the **Farquhar Machinery Co.** of Jacksonville, Fla. will both market Firth Sterling's line of Firthite tools, tips and blanks; high speed toolholder bits, drill rod and ground flat stock.

★ ★ ★

The Kalamazoo Mill Supply Co. of Kalamazoo, Mich., will distribute the company's Firthite tools, tips and blanks.

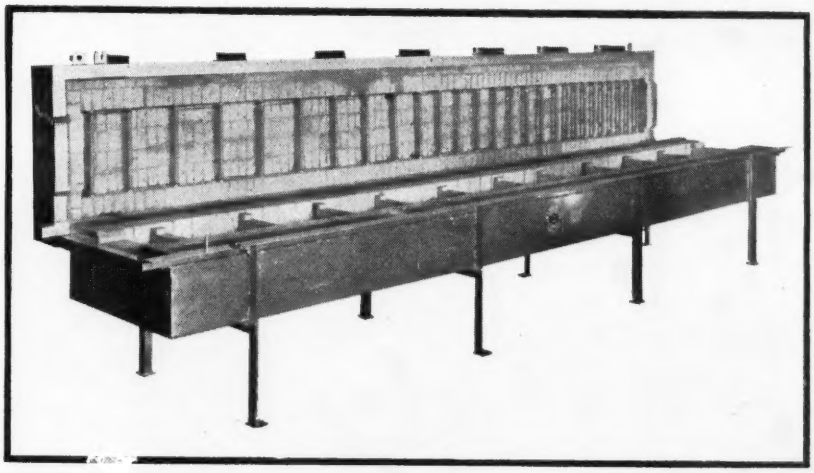
★ ★ ★

Athos Steel Service will handle the Firth Sterling line of tool and die steels, high speed toolholder bits, drill rod and flat stock in the Philadelphia and Eastern Pennsylvania trading areas.

Stanat Executive Dies

Richard L. Rossin, 46 a partner of **Stanat Manufacturing Co.,** Long Island City, N. Y., manufacturers of metal processing machinery, died of a heart attack on Friday evening, September 24th. Deeply shocked by his sudden death, **Stanley T. Wechsler** and **Nathan Raskin,** Mr. Rossin's surviving partners, announce that the business will continue to operate as heretofore, and that recently developed plans for increased facilities to serve Stanat customers will be carried forward.

Wire Annealing the Easy Way...



This may look like a Martian waffle iron. Actually it's a Rockwell continuous strand annealing furnace for brass, bronze and ferrous alloy wire that's doing a fine job in many wire mills.

The furnace has several operating advantages. Because it is hinged on one side, the upper half of the furnace can be readily raised for access to the entire interior. Multiple parallel tubes, through which the strands of wire pass, rest on brick piers and are readily available for removal or adjustment to any desired spacing. Protective atmosphere may be injected into the tubes ahead of the entry end of the furnace.

Dimensions depend on production requirements. The electric heating elements, mounted in the upper and lower halves of the furnace, provide uniform radiant heat to the tubes over the entire furnace area. We invite your inquiries.

ROCKWELL SINCE 1888 BUILT

W. S. ROCKWELL COMPANY

FURNACES • OVENS • BURNERS • VALVES • SPECIAL MACHINERY

2424 ELIOT STREET • FAIRFIELD, CONN.

Sales Representatives in Principal Cities

A Review of Recent Wire Patents

No. 2,688,171, PIN CLIP, patented September 7, 1954 by Hilda E. Anderson, Ironwood, Mich.

A pin clip is disclosed for holding decorations on packages or the like and comprises a single length of wire, bent to shape.

★ ★ ★

No. 2,688,172, CABLE CLIP, patented September 7, 1954 by David L. Kellems Company, Stonington, Conn., a partnership consisting of Vivien Kellems and David Loyal Kellems.

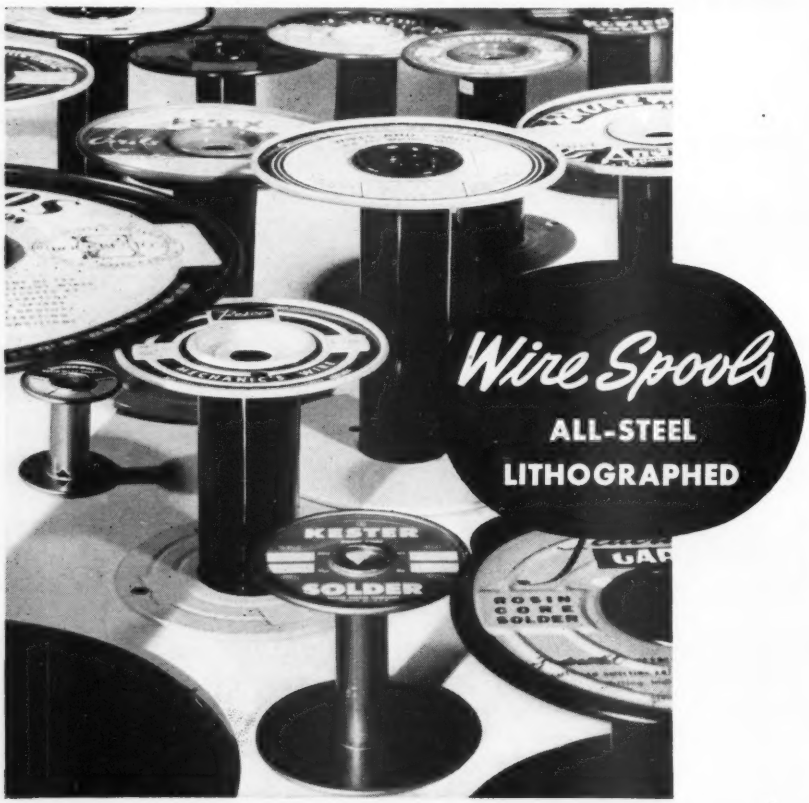
There are 19 claims in this patent to a grip comprising a number of wire strands interwoven to form an open mesh body adapted to be disposed in surrounding gripping relation with an article to be gripped.

★ ★ ★

No. 2,688,182, CERAMIC INSULATED WIRE, patented September 7, 1954 by Stanley O. Dorst, North Adams, Mass., assignor to Sprague Electric Company, North Adams, Mass., a corporation of Massachusetts.

A heat resistant, flexible, abrasion resistant insulated electrical conductor is disclosed comprising a flexible copper wire, a nickel-cobalt metal layer between about 0.000002 and 0.00001 inch thick deposited on the wire, the layer having between 2 and 50% cobalt, and a ceramic coating over the layer, the coating consisting essentially of sintered-together finely divided refractory ceramic particles and a polytetrafluoroethylene resin binder.

★ ★ ★



Ends and traverses may be shipped separately and assembled easily in your plant on a hand, foot, or power press.

5″ and 6-1/2″ diameter ends with 1-15/16″ diameter traverses.

10-1/2″ diameter ends with 3-1/2″ diameter traverses.

Traverse lengths up to 12″

J. L. Clark

LITHOGRAPHED METAL CONTAINERS

J. L. CLARK MANUFACTURING COMPANY • ROCKFORD, ILL.

No. 2,688,332, APPARATUS FOR REMOVING PAPER INSULATION FROM WIRES, patented September 7, 1954 by Charles H. Goodyear, Carlton Hill, and Ernest J. Gruen, Carteret, N. J., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

An apparatus for salvaging the wire and pulp from pulp insulated wire is the subject of this patent and comprises a device to advance the insulated wire longitudinally in a given path, a water bath, means to cause the insulated wire to travel through the water bath to soften the pulp on the wire and a device to direct jets of water under pressure toward the path to remove the pulp from the wire.

★ ★ ★

No. 2,688,333, APPARATUS FOR CONTINUOUSLY PROCESSING STRANDS, patented September 7, 1954 by Edwin T. Lorig, Ross Township, Allegheny County, Pa., assignor to United States Steel Corporation, a corporation of New Jersey.

A pair of cylindrical helically-conveying reels are adapted to receive and pay out the strands which extend into a tank of processing material, the strands being moved back and forth and each path being axially removed from the prior path.

★ ★ ★

No. 2,688,449, WIRE WINDING TOOL, patented September 7, 1954 by Leif E. Haagensen, Barrington, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

The tool is adapted for winding a connector wire around a cylindrical terminal in response to rotation of a bit forming a portion of the tool.

★ ★ ★

No. 2,688,450, COIL WINDING MACHINE, patented September 7, 1954 by Charles C. Bell, Warwick, R. I., assignor to Universal Winding Co., Cranston, R. I., a corporation of Massachusetts.

There are 14 claims to this electrical coil winding machine which is directed to the delivery of insulating sheets during the winding operation.

★ ★ ★

No. 2,688,453, STRIP WINDING APPARATUS, patented September 7, 1954 by Robert R. Barber, Idlewild, George E. Henning, Baltimore, and Bruno A. Raetsch, Parkville, Md., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

Apparatus is disclosed for winding a continuous strip of material into a number of separate coils of predetermined length.

★ ★ ★

No. 2,688,757, REINFORCEMENT FOR SPRING ASSEMBLIES, patented September 14, 1954 by Edward L. Bronstien, St. Paul, Minn., assignor to United States Bedding Company, St. Paul, Minn., a corporation of Minnesota.

The assembly includes bow-shaped flexible resilient reinforcing wires bridging the load-supporting faces of the assembly and severally disposed in planes

which are perpendicular to side frame members with helical tie wires embracing the ends of the reinforcing wires and also embracing opposite side frame members at the upper face of the assembly.

★ ★ ★

No. 2,688,790, FISHHOOK MAKING MACHINE, patented September 14, 1954 by Herbert A. Corbett, Auburn, N. Y., assignor, by mesne assignments, to Auburn Fishhook Company, Inc., Auburn, N. Y., a corporation of New York.

This machine is adapted to produce continuously wire fishhooks.

★ ★ ★

No. 2,688,889, COIL SPRING TREATING MACHINE, patented September 14, 1954 by Bruno E. Meyer, San Antonio, Tex.

The machine is adapted to stretch coil springs for treatment.

★ ★ ★

No. 2,689,268, ELECTRIC POWER CABLE, patented September 14, 1954 by Clarence B. Peck, Jr., Morristown, N. J., assignor to Anaconda Wire and Cable Company, a corporation of Delaware.

An electric cable is disclosed comprising a number of wire conductors each surrounded by a layer of insulation, a ground conductor positioned between the insulated conductors, a layer of electrically-conducting material surrounding at least one but less than all of the insulated conductors and the ground conductor and in contact with the ground conductor throughout the length of the cable.

★ ★ ★

No. 2,689,360, COMBINED WIRE DRAWING AND FORGING MACHINE, patented September 21, 1954 by Ben F. Ware, Euclid, Ohio, assignor to The Ajax Manufacturing Company, Euclid, Ohio, a corporation of Ohio.

More specifically, a wire drawing machine head is disclosed for the fabrication of non-circular metal articles from wire stock by cold working, a fabricating machine of the cold-header type having cutoff dies operable on polygonal cross-section wire stock for severing successive sections from the leading end thereof and a horizontally extending row of forming dies provided with polygonal die recesses for shaping such sections into nut blanks of polygonal shape.

★ ★ ★

No. 2,689,399, PLATED ARTICLE AND METHOD OF MAKING IT, patented September 21, 1954 by Alvin N. Gray, Edgewood, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

A composite electrical conductor is disclosed consisting essentially of a high tensile strength steel wire core, a corrosion protective thin inner layer of zinc covering the steel core, an intermediate thin barrier layer of lead covering the zinc layer, and an electrodeposited outer conductive layer of copper covering the lead layer and having a thickness of about one-eighth of the radius of the composite conductor.

★ ★ ★

No. 2.689.447, HIGH-SPEED TWISTING MACHINE, patented September 21, 1954 by Carl O. Bruestle, Metuchen, N. J., assignor to Syncro Machine Company, Perth Amboy, N. J., a corporation of New Jersey.

This is a wire twisting machine which includes a pair of spaced tubular trunnions rotatably mounted on a support on a common axis, a wire spool supporting cradle suspended from the opposed ends of the trunnions on free running bearings, and a light weight circular bow secured to the opposed ends of these trunnions so as to be rotatable about the cradle and consisting of a pair of axially aligned metal bands, a number of clamping members for holding the bands in parallel spaced relation, and wire guides mounted on the bands.

★ ★ ★

No. 2,689,761, BOTTLE CARRIER, patented September 21, 1954 by Alois Eberhard, Evansville, Ind., assignor of one-half to Jack A. Stone, Evansville, Ind.

The carrier is constructed of wire bent to the shape of a bail and a ring. There are six claims.

★ ★ ★

No. 2,689,994, WIRE SAFETY PIN UNIT, patented September 28, 1954 by Charles M. Clark, Clearwater, Fla.

This pin is formed mostly of a single length of wire, but bent into a somewhat complicated head.

★ ★ ★

No. 2,690,283, BOTTLE CARRYING AND SUSPENDING DEVICE, patented September 28, 1954 by Frank C. Comploier, Greenbelt, Md., assignor to The Hollinger Corporation, Arlington, Va., a corporation of Virginia.

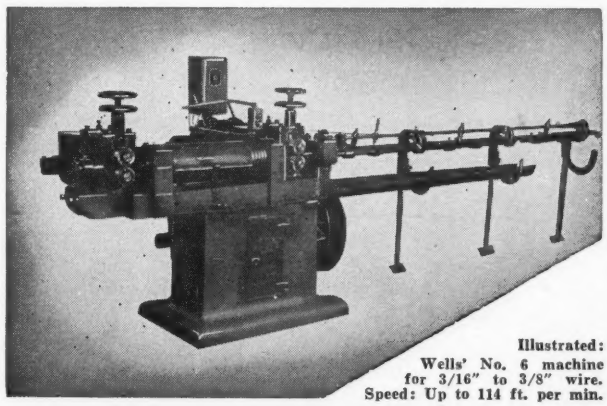
The bottle carrier, for a pair of bottles is fashioned of wire bent to form two recesses and a handle.

★ ★ ★

What do you want in your

STRAIGHTENER and CUTTER?

- **DEPENDABILITY?** **WELLS machines provide day-in, day-out continuous operating service.**
- **SPEED?** **These automatic rotary machines will not only give you speed, but accuracy as well.**



Illustrated: Wells' No. 6 machine for 3/16" to 3/8" wire. Speed: Up to 114 ft. per min.

Cuts wire in any length from 7½" up to 25'. Special attachment furnished on order for long lengths. Straightener flier runs in ball bearings. Gear drive and motor enclosed in base. Door provides accessibility.

58 years of experience and continuous engineering, with use of finest materials, have put WELLS machines in a class by themselves for excellence of performance. Built to handle the toughest jobs, year after year, with little or no servicing. Supplied in a complete range of sizes.

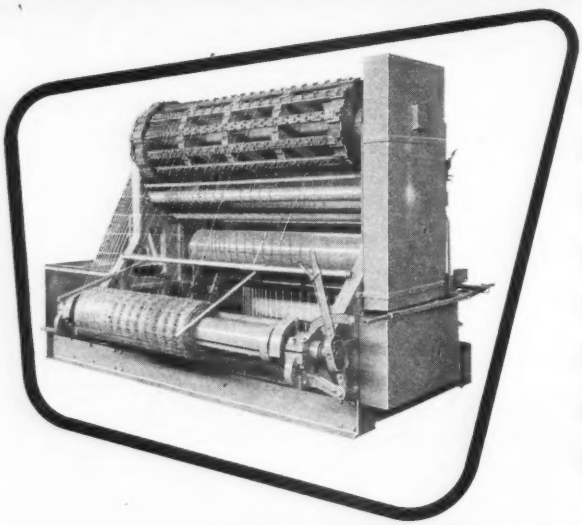
Send for Catalog covering the full line.

Frank L. Wells Company

KENOSHA • 5821 Fifth Avenue • WISCONSIN

Builders of Fine Wire Working Machinery

Interlocking FENCE LOOMS

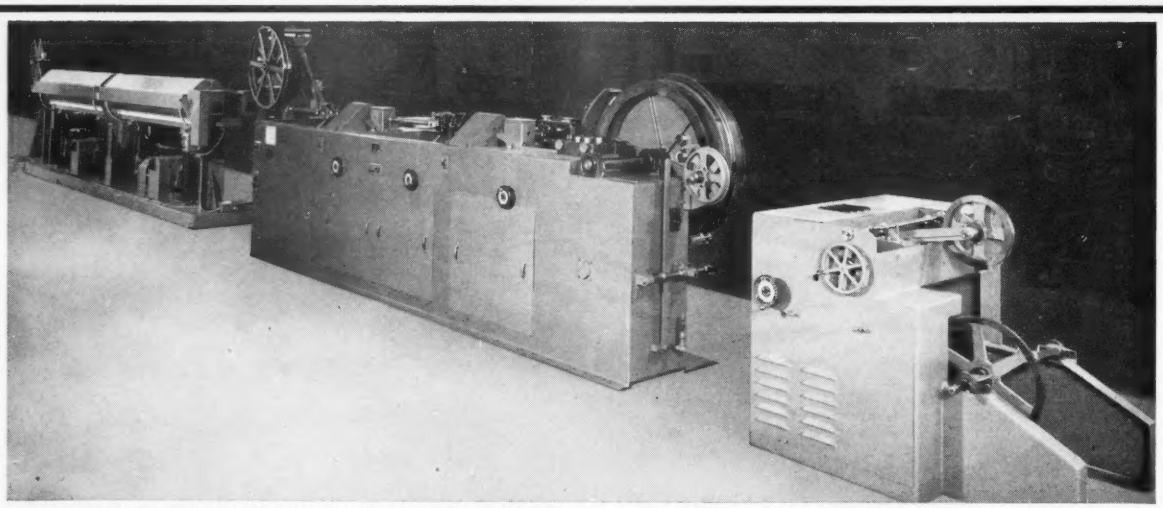


- Fastest — Most Efficient
- Preferred by Leading Mills
- Low Maintenance Cost
- Wrapped Stay Fence
- Straight Stay Wires
- Integrated — Space Saving
- Replaceable Main Bearings
- Single or Double Strands
- Years of Low Cost Production

Write for Detailed Information — Without Obligation

Interlocking Fence Co., Box 8, Morton, Ill.

Specialists In Fence Looms



4D-1-BB GLASS INSULATION WIRE COVERING MACHINE **No. 1088** Patented Aug. 3, 1943

WITH VARIABLE SPEED DRIVE.
TORQUE MOTOR DRIVEN TAKE-UP REEL STAND
BALL AND ROLLER BEARING MOUNTED
BAKING OVEN WITH DOUBLE VARNISH APPLICATOR
AND AUTOMATIC TEMPERATURE CONTROLS.

WIRE DRAWING, ENAMELING, TINNING, INSULATING,
TAPING, GLASS-COVERING, PANNING AND ALLIED MACHINERY

EST. 1855 AIMCO INC. 1915

"American" INSULATING MACHINERY COMPANY

REG. U.S. PAT. OFF.

FAIRHILL AND HUNTINGDON STREETS

PHILADELPHIA 33 PENNSYLVANIA U.S.A.

No. 2,690,469, FLEXIBLE, LOW-NOISE, ELECTRICAL CABLE, patented September 28, 1954 by Thomas A. Perls, Glen Echo, Md., assignor to the United States of America as represented by the Secretary of Commerce.

The cable comprises a stranded wire inner conductor, a dielectric surrounding the same, a flexible outer conductor surrounding the dielectric, conductive coatings integrally bonded to the inner and outer surfaces of the dielectric, the inner conductive coating fitting loosely around the inner conductor and the outer conductor fitting loosely around the outer conductive coating, thereby allowing the conductors to move freely with respect to the conductive coatings and insuring flexibility.

★ ★ ★

The information in this section is furnished by the patent law offices of LANCASTER, ALLWINE & ROMMEL, 438 Bowen Bldg., Washington 5, D. C. Data listed is only a brief review of recently issued patents obtained by various U. S. Pat. Off. registered attorney for manufacturers and/or inventors. Complete copies may be obtained direct from Lancaster, Allwine & Rommel by sending 50¢ for each patent desired. Outside of the U. S. and Canada the cost is $1.00 for each copy.

A Report of Product News

Under the above heading, **Industrial Wire Products Corp.,** 5649 Alhambra Ave., Los Angeles 31, Cal., has issued a number of bulletins describing their products and services. The company manufactures wire, wire cloth and wire products in steel, galvanized, brass, monel, copper, aluminum and stainless wire.

★ ★ ★

Among the company's recent acquisitions is a new flat wire rolling mill, said to be the only one of its kind on the West Coast. It can roll flat wire into nearly five hundred different sizes, which is furnished in coils or cut into lengths to specification. The rolling mill's capacity is 2000 pounds per day.

★ ★ ★

Wire cloth and fabrics are furnished in a large variety of types from woven fine filter screening to heavy welded wire fabrics. Reinforcing mesh for masonry is one of their specialties.

★ ★ ★

The company is headed by **E. R. Potter,** who has been in the wire industry for something like twenty-six years, starting as a wire drawer and rising to a managerial post. In 1944 he established his own company, which has grown steadily in the last decade, now occupying some 40,000 square feet of floor space.

★ ★ ★

Copies of these bulletins will be sent upon request to interested persons.

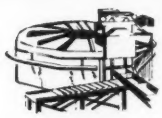
To Broaden Wire Machinery Line

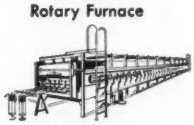
The Torrington Manufacturing Co., Torrington, Conn., has announced it has changed the name of its **Spring Machinery Division** to the **Wire Forming Machinery Division** so that the name will more adequately describe the function of that particular phase of the firm's machinery operation.

★ ★ ★

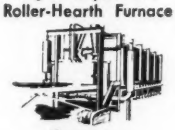
Andrew Gagarin, president, said the change is being made at this time because the company has gone into the manufacture of four slide machines, torsion spring winding machines and precision carbide tools for spring machinery.

MODERN GASMACO FURNACES


Gasmaco
Rotary Furnace


Gasmaco
Wire Patenting
Furnace

Gasmaco
High Temperature
Roller-Hearth Furnace


Gasmaco
Car Type Furnace

The steel industry's demands for higher production in limited space are satisfied by Gasmaco-developed (and patented) silicon carbide tubes and rollers. They permit continuous operations in controlled atmosphere up to 2500° F.

When applied to wire patenting furnaces or continuous rod mills, Gasmaco radiant tubes permit increased production at higher temperatures with substantial reduction in scale loss.

Designers, fabricators, and erectors of gas generating equipment for more than 50 years. Let our experienced engineers help you.

✓ First with Gasmaco

THE GAS MACHINERY COMPANY
16118 WATERLOO ROAD
CLEVELAND 10, OHIO

Designers • Fabricators • Erectors
Gas Plant Equipment and
Industrial Furnaces
THE GAS MACHINERY CO. (Canada), Ltd.
HAMILTON, ONTARIO

Representatives In
BIRMINGHAM • BOSTON • CHICAGO • ST. LOUIS

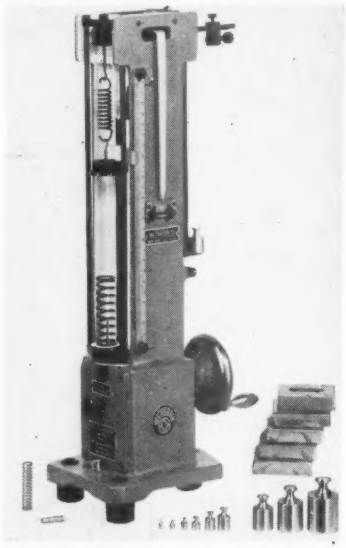
Output of the division formerly was limited to machines designed for the production of conventional extension and compression springs.

★ ★ ★

In addition to the Wire Forming Machinery Division, the Company, —with subsidiaries in Van Nuys, Calif., and Oakville, Ont.—produces more than 325 different air impellers and a number of types of auxiliary mill machinery.

Small Spring Tester

Testing small compression and extension springs for loads and deflections can be done with extreme accuracy on this newly redesigned precision instrument. Both general purpose or occasional testing and high quantity production testing can be done by setting tolerance markers and automatic stops. The capacity is 1/64 ounce to 12½ pounds with spring lengths from ⅛ in. to 12 in. long. Lengths can be read directly by a Vernier scale and a pointer to .005 in. without the aid of a dial indicator. This instrument will be especially useful in government arsenals for testing small centrifugal pin springs, fuse springs and other springs having



Carlson Spring Tester * * * * * * *

precision requirements. The accuracy is guaranteed within ¼ of 1%.

★ ★ ★

Descriptive bulletin available from The Carlson Company, 277 Broadway, New York 7, N. Y.

Dewpoint Measurement

Instrumentation Data Sheet 10.5-la describes the **Surface Combustion Corporation's** Dewpoint Recorder including details about the new multiple source type which automatically records dewpoints from 6 different sources in rapid succession. This data sheet is available from the **Industrial Div., Minneapolis-Honeywell Regulator Co.,** Wayne & Windrim Aves., Philadelphia 44, Pa.

New Guillotine Billet Shear Has Travel Synchronized With Moving Billet

The new Manco Hydraulic Guillotine Billet Shear has a free travelling mount so that as the shear blades penetrate the moving billet the pull of the billet moves the shear. In this manner the shear mount is moving at the same speed as the billet and the cut can be made without slowing production.

★ ★ ★

International Wire Products Corp.

Midland Park, N. J.

Fabricators of copper, stainless, monel, and steel strands and cables in the fine sizes.

We invite special constructions for experimental cables and strands —for use in Engineering Department work.

We specialize in strands and wire for the costume jewelry trades— Gold colors and silver color strands and wires.

Our facilities include wire drawing, tinning and stranding of single end and multiple wires.

Strand annealing furnace for monel, stainless and silver plate wires —including phosphor bronze and brass from .040 to .002 fine sizes.

This new unit delivers 125 tons cutting thrust to shear a 4-½" steel billet in ten seconds. Weight of the cutting unit without mount is 1100 lbs. Because the cutting action takes place while the billet is at approximately 1300° F, the complete Guillotine is jacketed for water cooling. A high pressure hydraulic pump is the power source.

★ ★ ★

Complete information may be obtained by writing to the **Manco Mfg. Co.**, Bradley, Illinois.

Industrial Gloves Designed for Handling Metal Safely

Work gloves that are particularly effective for handling metal sheets, plates and parts that are (1) hot, (2) sharp-edged or (3) oily or greasy are made by **Jomac Inc.**

★ ★ ★

Known as Jomac gloves, they are a little higher in cost than canvas gloves, but will outwear canvas as much as 900 percent. They are available also with a plastic coating, known as Armorkote, for even greater resistance to abrasion and cuts and for use where complete oil-resistance is required.

★ ★ ★

Secret of the safety and long life of these gloves is in the construction of the cloth from which they are made, which is a thick, twisted loop pile fabric, containing thousands of tiny air cells to insulate against heat and cold.

★ ★ ★

The pile cushions against the cutting action of sharp-edged materials. The twisted knit loops present a slightly roughened surface so that smooth and slippery objects may be safely grasped.

★ ★ ★

The heat-resistant grades of gloves are made from extra-heavy cloth suitable for most high temperature applications. They are much stronger and cooler than asbestos. Jomac cloth retains full flexibility and does not dry out and stiffen like leather.

★ ★ ★

Jomac Inc., is located at 6128 North Woodstock Street, Philadelphia 38, Pa.

Scovill Used Magic at Metal Show

Scovill Manufacturing Company's Mill Products Division turned to the magician's art to dramatize the properties and qualities of its brass strip, rod, wire and tube. The demonstration featured the firm's exhibit at the National Metal Exposition in Chicago.

★ ★ ★

Two professional magicians were retained to perform a score of different illusions and tricks to highlight such Scovill claims as that its brass cold-heading wire "makes tough-to-make parts look easy" and that its High Speed brass rod "machines like magic." For "props" the magicians used brass wire, rod, tube and strip from the exhibit.

★ ★ ★

The setting for this new type of showmanship was the Scovill booth which reproduced in miniature a brass warehouse. Decorations featured the company's three-color trademark: yellow, red and silver, representing the basic metals — brasses, bronzes, nickel silvers and aluminum — products of Scovill's Mills Division.

"Switching to NILSON 4 SLIDES Saved us $17,656 on metal alone"
Yes, simply by changing stamping methods, this NILSON Customer profited 4 ways:
1. Production increased 80%.
2. 72% less metal used (per 4 million pieces).
3. Greatly improved quality with minimum of rejects.
4. Strengthened competitive position with greater profit margin.
You, too, can enjoy these advantages in producing your own wire forms and small metal stampings. Parts such as illustrated in the margin were straightened, fed, pierced, blanked, swaged, stamped or coined, cut-off and formed AUTOMATICALLY in NILSON 4 SLIDES in one quick precise operation. ONE Machine. ONE Operator.
NILSON 4 SLIDES available in wide range of sizes: forming Wire up to ½" diam. in feeds to 32" max. and Metal Ribbon stock up to 3½" wide. Press sections 5 to 30 ton capacity. Heavy Duty Types in 50 and 75 ton models.
MODEL S-3-F Nilson 4 Slide with No. 51B Nilson Tilting Stock Reel.
THERE'S NOTHING LIKE A NILSON
Write, Wire, Phone for full particulars.
THE A. H. NILSON MACHINE COMPANY
1516 Railroad Avenue • Bridgeport 5, Connecticut
Automatic Chain-Making Machines • Automatic Staple Forming Machines • Wire and Stock Reels • Foot Presses • Wire Straightening Equipment • Slide Feeds for Presses

New Tantalum Tungsten Carbide Round and Shape Die Catalog

Vascoloy-Ramet Corporation of Waukegan, Illinois have just published a new Die Catalog which includes complete ordering information on all V-R Dies for drawing wire, rod, bar and tube. The new die catalog is divided into three sections; round hole dies, square and hexagon shape dies and rectangular shape dies for easy reference to a particular die. The round hole die section is further subdivided into sections by finished product including wire dies, wire and rod dies, rod and tube dies and bar and tube dies. This subdivision makes it easier to select the desired size round hole die required. Listed in the catalog are 22 sizes of round hole dies, 13 sizes each of square, hexagon and rectangular shape dies. Copies of the New Vascoloy-Ramet Die Catalog VR-461 may be obtained by writing the Vascoloy-Ramet Corporation, Waukegan, Illinois.

Introduces Hook-Up Wire with Teflon Insulation

Expanded manufacturing facilities at **Hitemp Wires Inc.** have enabled the company to offer extruded teflon coated wire for high temperature service (Class H or better). The first item being produced is a stranded hook-up wire, tradenamed Temprex.

★ ★ ★

Being coated with a smooth Teflon sheath, Temprex is impervious to all known commercial solvents. Insulation remains unaffected by weathering, aging, fungus or moisture. It meets the rigid requirements of MIL Standard 104, and MIL-W-16878A for type E and EE constructions. Temperature resistance is excellent: ambient temperature from —90° to +260°C will not change electrical or physical characteristics of the wire.

★ ★ ★

The new wire is being made in a wide range of sizes from 26—10 AWG inclusive. Fourteen standard colors are available for applications where wire identification is a problem. Available in production lengths, without wastage.

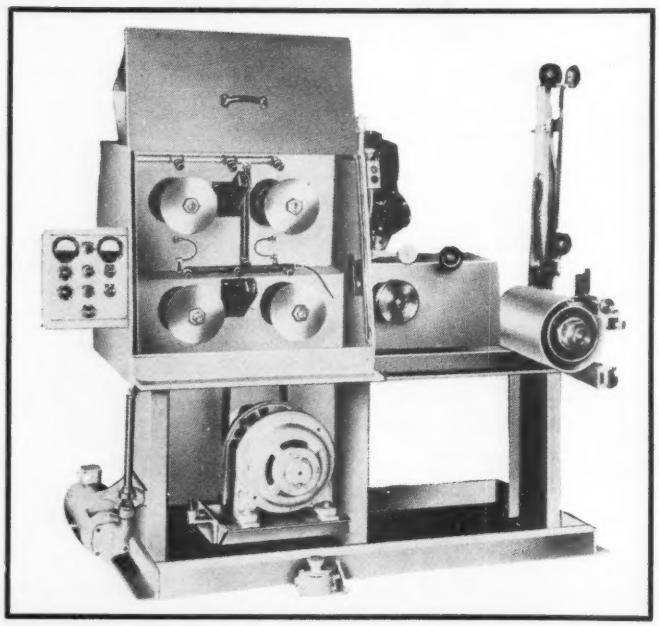
★ ★ ★

Additional extruded wire types are currently in development. For additional information, or for engineering assistance with high temperature problems, write to Hitemp Wires Inc., 26 Windsor Ave., Mineola, L. I.

Hand-Torch Brazing Table Available

The Engineering Division of **Handy and Harman,** 82 Fulton St., New York 7, N. Y., has compiled a hand-torch brazing table showing the minimum lengths of silver alloy wire required for brazing pipe and tubing joints, for pipe diameters ranging from ¼" to 4" and socket depths of 17/64" to 29/32". A method of determining the lengths of wire for other sizes than those given in the table is included. The table will be sent upon request.

Meet "Model F-31"—*an artist at drawing* FINE WIRE!



SPECIFICATIONS:

- Maximum Wire Entering Size.....#14 B & S Gauge
- Finished Wire Size.....#26 to 34 B & S Gauge
- Operating Speed.....5,000 ft. per minute
- No. of Dies....16 • Motor Size..15HP
- Size of Die Case, 1" x ½" thick
- Spool Capacity.....40 lbs.
- Net Weight .....Approximately 2,900 lbs.

Model F-31 is unique in the respect that it is designed with an over driven spooler, viz. no slip and consequently no wear on the finishing capstan. Pre-set tension of the spooler eliminates scuffing and splintering of the finished wire.

The spooling unit (driven from the main unit) is equipped with a clutch control which maintains uniform wire speed throughout entire spooler build-up. Wire tension regulation can be done while the F-31 is running. The unique design and simple operation of this FINE WIRE DRAWING MACHINE insures ease of string-up and low maintenance cost.

Inquiry By Phone or Letter is Cordially Invited

COOK *MANUFACTURING COMPANY*

50 EAST 25th STREET • PATERSON, NEW JERSEY • ARMORY 4-6380

Allowable Working Stresses for Springs

(*Continued from page* 1323)

ance Limit Curves in Fig. 7, engineers can design springs that will give infinite life. It is believed that use of these curves will not only simplify spring design but also produce designs that will properly satisfy the required applications so that springs in the future will not fail as often as they have in the past, and thus will perform a great service to industry and to the Armed Forces.

BIBLIOGRAPHY & REFERENCES

TECHNICAL PAPERS:

1. "Copper Base Alloys for Springs" by Harold C. R. Carlson, "Product Engineering"—February and March, 1949.
2. "Permissible Stress Range for Small Helical Springs" by F. P. Zimmerli, University of Michigan, Research Bulletin No. 26.
3. "Stainless Steel for Springs" by Harold C. R. Carlson, "Product Engineering" — May and June, 1947.
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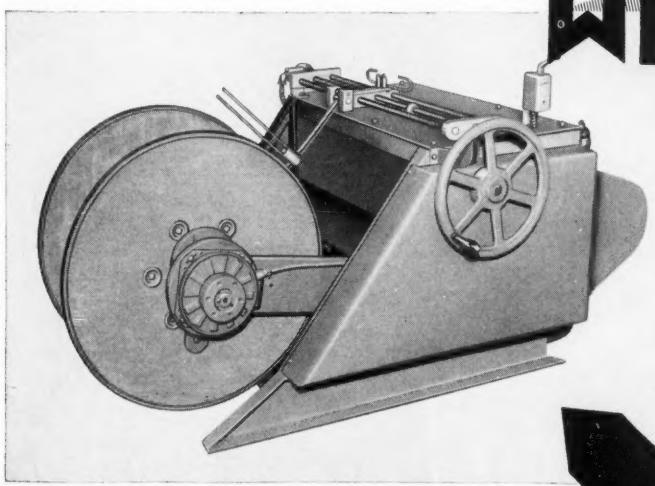
Fig. 10

PROPERTIES OF COPPER BASE and SPECIAL ALLOYS

MATERIAL (Commercial Name)	SPECIFICATIONS IN GENERAL USE	MODULUS OF ELASTICITY	WEIGHT lbs.per cu.in.	RECOMMENDED ROCKWELL HARDNESS
Spring Brass Type 70-30	A.S.T.M. B134-46 (6) Federal QQ-W-321 (C) S.A.E. 80	G 5,000,000 E 15,000,000	.308	B89-B93
Phosphor Bronze Type 5% Tin	A.S.T.M. B159-46 (A) S.A.E. 81 Navy 22W5 Federal QQ-W-401	G 6,000,000 E 15,000,000	.320	B95-B105
Beryllium-Copper Type 2-1/4%	A.S.T.M. B197-51T AMS 4725A MIL-C-6941A	G 7,250,000 E 19,000,000	.315	C37-C40
Inconel & Inconel X	Navy 47N12 & OS-651 Navy W-41 Fed.QQ-W-390	G 10,500,000 E 28,500,000	.309	C38-C42
Monel	Navy 46M7 Fed.QQ-N-281	G 9,500,000 E 26,000,000	.319	C25-C30
K-Monel	Navy 46N5a Fed.QQ-N-286	G 9,500,000 E 26,000,000	.306	C30-C36
Z-Nickel	Special	G 11,000,000 E 30,000,000	.316	C41-C45
NI SPAN C	Special	G 10,000,000 E 26,500,000	.294	C40-C44
Elgiloy	Special	G 12,000,000 E 29,500,000	.300	C54-C58
Iso-Elastic	Special	G 9,200,000 E 26,000,000	.294	C30-C36



WIM *Shaftless*

TAKE-UP STAND

WIM equipment is designed for faster more efficient wire handling. This high speed machine will handle the most exacting assignment with complete ease and dependability under the most severe production conditions. Write today for further information. Our engineering staff, experienced in the wire handling machinery field, will be glad to help you with your special problems.

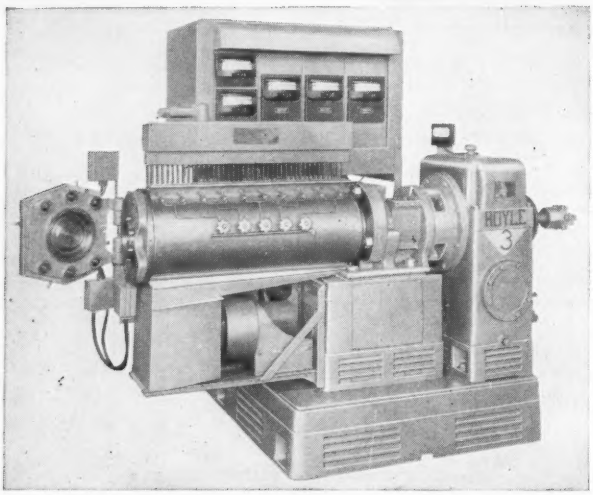
Engineered to save you time, money, and effort, the Shaftless Constant Tension Take-up Stand is one example of WIM wire handling equipment.

WIRE INSULATING MACHINERY, INC.

Division of Machinery Electrification, Inc.

Northboro Mass., U.S.A.

FASTEST HEATING FASTEST COOLING



Here are some of the time-tested, money-saving reasons more and more plants are standardizing with Royle Spirod* Extruders for processes requiring maximum flexibility in controlled temperatures — constantly maintained and accurately zoned:

- **Extra heavy walled cast steel cylinders that will not warp. No joints to leak when pressures are high or crevices to collect burned compound that would cause contamination.**
- **Heavy duty large diameter heating elements, that can be used with 440 volts without step-down transformers, provide radiant heat to cylinders and heads.**
- **Any heating element may be removed and replaced without disturbing other elements or wiring.**
- **A cooling system with ten times the capacity of conventional designs can be modulated through its entire temperature range without drastic changes. Ample cooling for all compounds at maximum speeds.**

No. 3 Royle Spirod Extruder. Completely insulated and equipped for evaporative cooling.

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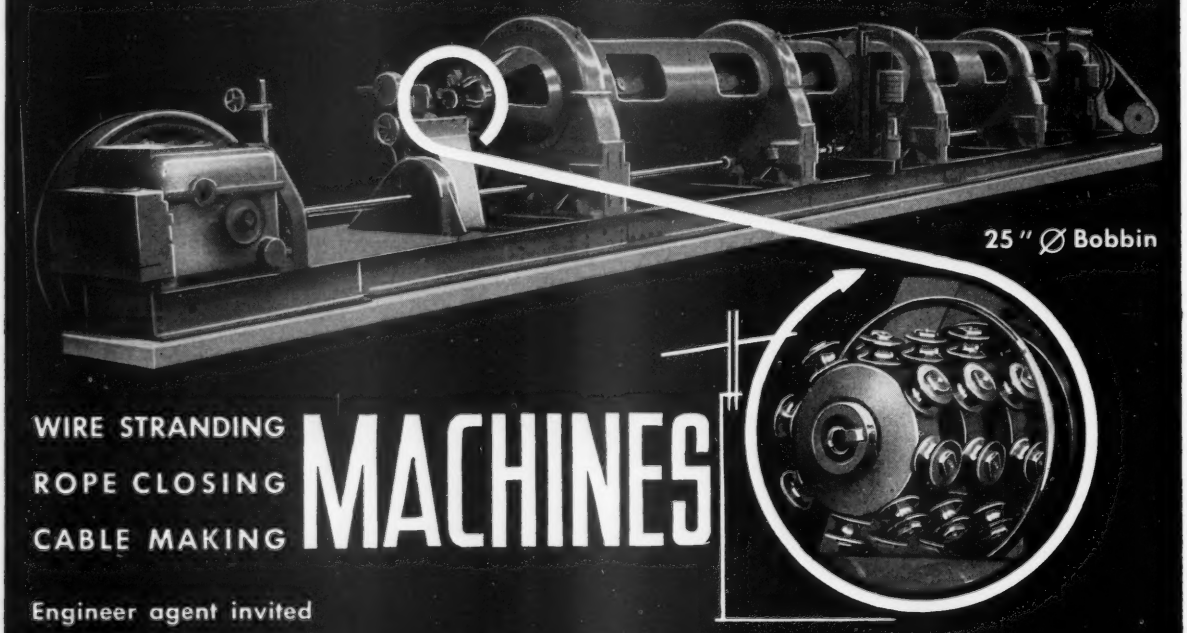
NIEHAUS High-Speed Tubular Stranding Machine



WIRE STRANDING
ROPE CLOSING
CABLE MAKING

MACHINES

Engineer agent invited

MASCHINENFABRIK K. A. NIEHAUS · GERMANY
DÜSSELDORF-RATH

5. "Spring Steels" by Harold C. R. Carlson, "Product Engineering" —January, February and March, 1942.
6. "Design Stresses for Beryllium Copper Parts" by R. W. Carson, "Electrical Manufacturing" — March, 1948.
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12. "Theory & Design of Springs" by F. M. Cousins, Edwards Bros., Ann Arbor, Michigan.
13. "Manual on Design of Springs for Ordnance" by War Engineering Board, Society of Automotive Engineers, New York.
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16. "Mechanical Springs" by Barnes-Gibson-Raymond Division of Associated Spring Corp., Detroit, Michigan.
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18. "Mainspring" by Wallace Barnes Co., Bristol, Connecticut.
19. "Data Book" by Hunter Spring Co., Lansdale, Pennsylvania.

Wire Ropes Used in Logging Described in New Bulletin

A new bulletin has just been released by the **Macwhyte Company,** wire rope manufacturers, called "Wire Rope for Logging," Number 5434.

★ ★ ★

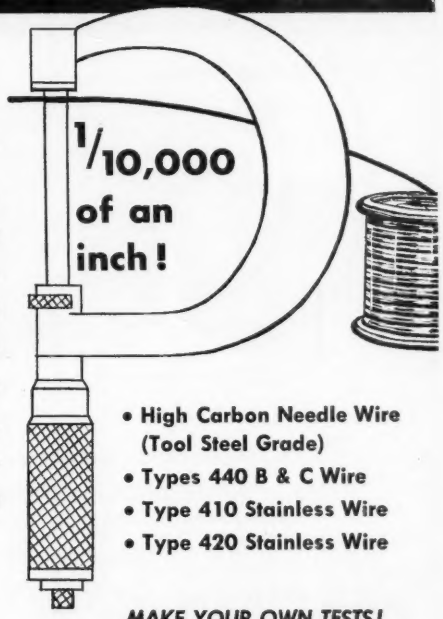
With illustrations and complete descriptions, wire rope for each logging need is explained. The purpose of this technical bulletin is to take the guesswork out of ordering logging ropes and to show the particular types of ropes best suited for each logging operation.

★ ★ ★

A copy of this bulletin No. 5434 may be had by writing direct to Macwhyte Company, Advertising Department, Kenosha, Wisconsin.

WANT FINE WIRE ACCURACY FOR SMALL PRECISION PARTS?

WEBB dies are accurate to...



Let Webb put an end to tolerance, size and finish worries on your fine wire needs. Diligent maintenance of Webb dies assures you of superior product performance for your pins, shafts, pivot staffs, drills, points, etc. Enjoy the benefits of using fine wire made from *specialty* steel.

- High Carbon Needle Wire (Tool Steel Grade)
- Types 440 B & C Wire
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The Carpenter Steel Company

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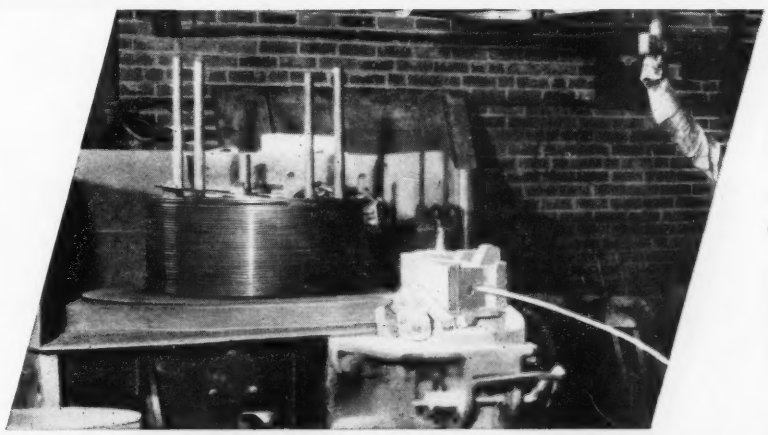

DON'T LET YOUR DIES DOWN

The heart of your drawing machines is the dies. Their failure means wire products that are damaged or off-size. Gold Bond High Calcium Quicklime, used in the lubrication process, is the best protection you can give your dies. Its high purity, and uniform size and composition, assures best adherence of lubricant on the rod surface...with less wear on dies. And Gold Bond's high quality permits you to *use one-third less lime* as an adhering agent for your lubricant. Your Gold Bond representative can supply you with full technical data.

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INDUSTRIAL PRODUCTS

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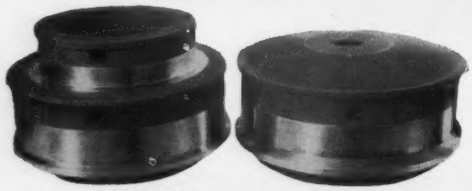
CUT YOUR OPERATING COSTS
WITH HARDSURFACED:

Saves down time . . .
wire rejections . . .
increases production



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3 to 10 times as long as
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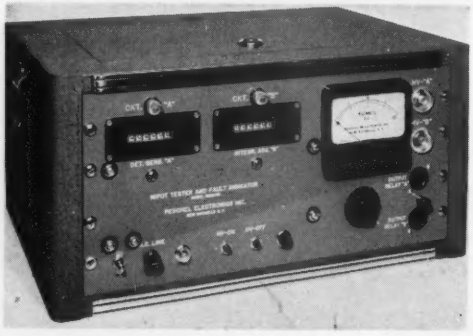

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Heavy duty HV Dielectric Test Sets (for tank testing of large reels of wire cable).
Corona Ionization Test Sets.
HV Test Sets, all types: AC, DC, AC/DC.
Spark Testers, Pin hole counters.
Sensitive Hipot Testers.
Bench spoolers.

Demonstrations Arranged

- Continuous production type.
- For non-destructive testing—will not burn or mark wire.
- Combination unit—applies 2 tests simultaneously:
  For "Spark Testing" without marking wire.
  For Pin Hole Detection and Counting.
- Dual test electrodes, detectors, and magnetic counters.
- Adjustable output voltages—0 to 20,000 Volts, AC or DC.

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PESCHEL ELECTRONICS, INC.
13 Garden Street Tel.: NE 6-3342 New Rochelle, N. Y.

Composite Wires by Electroplating

(*Continued from page* 1326)

Vinyon have been successfully used.

Base Material

Although little mention of the base material has been made, the success of this particular method of plating depends largely on the mechanical perfection with which the wire progresses through the tank. The base wire should be uniform in size within a coil and from one coil to another since the coils are welded together to make the process continuous. The wire to be plated is first straightened to eliminate any localized differences in residual cast, then formed into a progressing helix with a given diameter. Even small variations in the coil diameter would cause the wire to change its distance to both the inside and outside anodes resulting in plating thickness variations or perhaps burning. It is difficult to hold such helix uniformity if the size of the wire varies much more than .001 inches in diameter. To assure best uniformity it may be advisable to draw the wire through a sizing die before it enters the straightening and helix forming mechanism. The sizing pass, straightening, forming and carrying roll may be synchronized as a continuous operation.

★ ★ ★

The temper of the base wire is also important as variations will again prevent the helix forming device from holding the necessary coil diameter. Since the wire must remain at the proper distance from the anodes, soft wire is difficult to handle. It has a tendency to kink as it is being removed from the reel and also sags under its own weight to form an oval shape as it progresses through the tank. In this case, it may run too close to the bottom of the outside anodes. On the other hand, wire which is too hard has the disadvantage of being hard to straighten properly. Depending upon the kind of base wire being plated, the temper, for best re-

sults, will usually fall within ¼ to ½ hard.

★ ★ ★

The surface of the base wire is also very important since the deposited coating will not bridge across slivers, laps, seams, pits, deep scratches or other mechanical defects. Even though the composite may appear to be satisfactory on the surface after being plated or drawn to a smaller size, it will be inferior and unfit for many applications. A flaky surface sometimes noticed on copper and brass can be very serious. Die-scalped material is considerably better as a base material and is recommended when it is available.

★ ★ ★

The incoming rod should be clean, smooth and free from heavy grease or scale. If the acid pickle in the cleaning portion of the unit is strong enough to remove heavy scale on some coils, others may lose considerable metal. Although it is desirable to etch the surface of the wire to promote a good mechanical bond, this is a very fine micro-etch and not the rough surface caused by over-pickling.

Coating Prior to Reduction

As mentioned previously, a clean surface is absolutely necessary for the deposit of a smooth adherent metal plate and it is equally important in the coating of the rod or wire prior to cold reduction if we are to prevent metal-to-metal contact in the die. The coating not only neutralizes any remaining acid but also serves to hold the lubricant either mechanically or chemically on the surface of the wire during reduction. We may also be reminded that a good coating should protect the metal surface from oxidation that may form when there is a lapse of time between dipping and actual drawing.

★ ★ ★

The coating is even more important to the reduction of composite materials since we usually have a thin outside shell of metal with entirely different work

AN EXAMPLE OF HAMELIN SERVICE ON A RUSH ORDER FOR WOOD REELS

We received the order at 4 P.M. Friday, Sept. 24th. The trailer shown in this picture left our plant at 3:30 P.M. on Monday, Sept. 27th, arriving in Toronto, 350 miles away, at 8:30 A.M., Sept. 28th.

We don't do this every day, but can — and will — when reels are needed.

• WOOD REELS •

ALL SIZES • ALL TYPES

STANDARD • SPECIAL

IN ANY TRAVERSE WIDTH

Note that the instance cited above included a Sunday, so that we had only 2 working days to fill this urgent order. This is one of many examples of the service extended to HAMELIN customers.

May we serve you?

J. HAMELIN LUMBER & WOODWORK LTD.

2890 NOTRE DAME STREET • LACHINE, QUEBEC, CANADA

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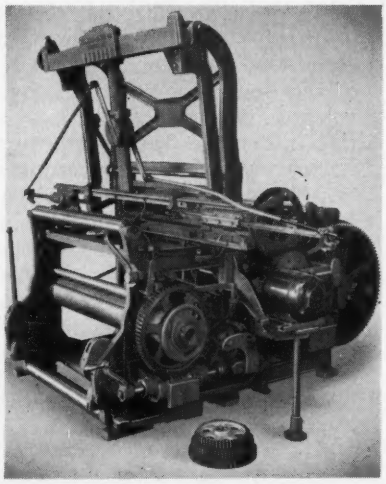
NEW MODERN FLY SCREEN WIRE LOOMS

Four Sizes: 36", 48", 60" and 72" Widths



TYPE No. 239

Made in 36" and 48" widths:

Shown at the left.

TYPE No. 239-360

Made in 60" and 72" widths:

These larger looms have stronger frames and heavier construction throughout.

The take-up and screen tension of the 60" and 72" widths, is effected through a ratchet, instead of the usual worm gear and weight arrangement.

Speed changes of the loom are made by changing different sizes of the motor drive pinions.

On the 48" width and wider, extension slides are provided to support and guide the longer shuttle bars.

Steel shell warp drums are used.

All looms are provided with an electric stop, which instantly stops the machine when either a warp or a cross wire breaks.

write for details on this or other type looms you may need

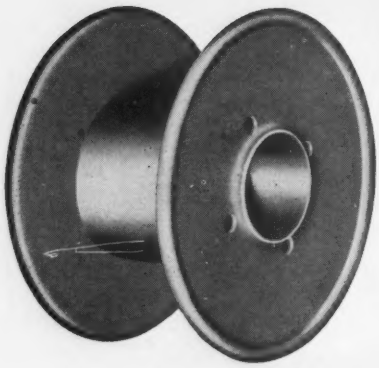
We make four heavier types.

MUMMERT-DIXON CO.

HANOVER 3, PENNSYLVANIA

Best for today's

HIGH SPEEDS



Industry's tireless search for greater efficiency is constantly posing new problems in high speed for the wire industry. This has underscored, as never before, the need for correct design and careful construction of reels for wire drawing machines.

For over a half century, Apco Mossberg has produced reels of highest quality. Apco Mossberg High Speed Reels are manufactured to extremely close tolerances — with particular emphasis on trueness and balance.

Here's something else. It's standard practice at Apco Mossberg to give each and every inquiry about steel reels, spools or bobbins individual attention. Bring your next problem to Apco Mossberg. Without obligation, an Apco trained engineer will be glad to offer suggestions and solutions to your particular problems. Write for further details.

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ATTLEBORO, MASS.

hardening characteristics than the base wire itself. In order to assure absolute surface cleanliness it is often advantageous to include a coating dip at the take off end of the plating unit. This may, however, create a false sense of security if we fail to consider the fact that such coatings are hydroscopic and deteriorate with age. It is obviously unwise to trust a coating which has aged beyond a reasonable period of time. Such timing is often left to the discretion of the mill men and trouble ensues.

* * *

Each mill may find a different coating and method of application best suited to their particular operations. Likewise, different composite wires require individual coating techniques. There are many different types of compounds on the market today which have been found to perform reasonably well when properly applied. However, most of these are hydroscopic and there is a tendency to break down under the terrific speeds required by today's economy.

Drawing Lubricants

There is such a diversity of procedures for reducing various composite materials that it would be impossible to consider each case in an article of this size. Most of these procedures have to be developed and adapted to the particular composite for greatest economy and efficient production. Whether water soluble type soaps, insoluble dry soaps, oils or high temperature solid lubricants are employed depends upon the materials being drawn and the conditions of operation. With plated composites, consideration must be given to both the plating and the base metal since their drawing characteristics may be entirely different.

* * *

The type drawing compound, method of application, soapfat concentration, speed of drawing, temperature and solution concentration will be governed largely by the composite materials to be reduced as well as the size of the

Handwriting of a man about to discover

the secret of cutting, forming, and grinding metals at top rates . . . with fewer rejects and longer tool, die, and abrasive life. You too will benefit from the modern compounds developed by specialists with 23 years of engineering and manufacturing experience. What's more, you'll like the friendly, cooperative approach that Bick engineers take in solving lubricant problems. To get the most out of your machines, always call Hans C. Bick to smooth and cool the way.

Hans C. Bick INC.

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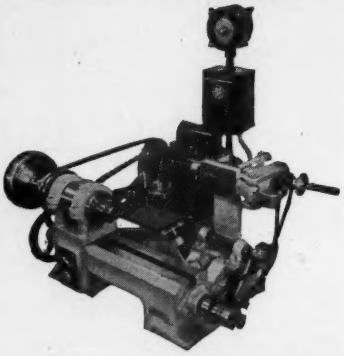
CUT
Die Room
COSTS
50%
with the New
type "M"

DYKREX
"IT CORRECTS THE DIE"

automatic
Polishing Machine



Double your finished Tungsten Carbide Die production

•

Save ½ labor costs—

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The new automatic polisher with the Time Switch—

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It is completely assembled—just plug it in!

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The Standard of the Wire Industry

wire. Heavy sections of nickel on steel may be drawn with dry soaps which are usually calcium or aluminum. Copper plated materials, as a rule, yield best results by wet methods. We have noticed, however, that a pass first through tallow affords satisfactory results.

* * *

Intermediate sizes within the range of .040" to .005" are reduced by use of fluid type compounds. Percent reduction per die varies somewhat with the material. Nickel plated steel can be reduced by 30% each pass, while nickel on copper produces best results with smaller reductions of 15%.

* * *

Fine wire .005" or smaller is drawn at much higher speeds and requires a more dilute solution[6]. At these higher speeds, care must be exercised to prevent deposits on the wire caused by the break down of free fats[6]. Such deposits may cause breakage of the wire in the dies.

* * *

It is desirable to keep the temperature of the solution in the medium wire unit below 140°F. and the fine wire solutions even less, 110°F. maximum.

* * *

The pH range of 8.5 to 9.8 appears best for all around work. Improper cleaning or tanks standing over periods of time may produce fatty acids to cause a pH drop, however, this can be restored by small additions (2 ounces per 100 gallons) of caustic soda[7].

Drawing Dies

Although the wire industry has set high standards of technical development, the most efficient die shape is still a controversial question. Most wire men have formulated opinions as to the correct die angles most suitable for their own particular material, kind of lubricant, percent reduction, etc. The cost of our final wire product is undoubtedly affected by the efficiency of our dies and the lubricant. The entrance angle, the bearing length and the

MASON STYLE
NON-RETURNABLE
METAL
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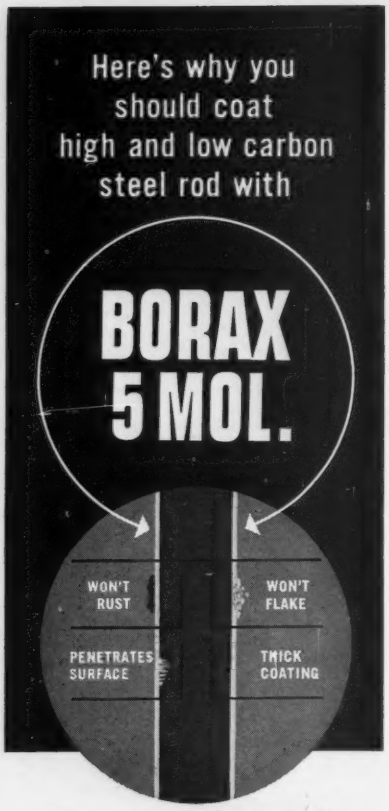

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No Baking... The Borax solution penetrates the porous surface of the metal, neutralizing deepseated acid, and eliminating the need for baking.

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Economical... A single dip in the Borax bath provides a thick durable coating which is very valuable where the wire is to be drawn in several stages.

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blended radii must be controlled[8] to:

1. **Minimize the power required.**
2. **Minimize friction.**
3. **Reduce wear.**
4. **Keep the temperature low.**
5. **Maintain high speeds.**
6. **Extend the life of the die.**
7. **Yield a satisfactory surface finish.**

★ ★ ★

There is one point that must not be overlooked. Even though the die contour best suited for a given operation has been established, measures must be taken to assure that the drawing machine operator is getting a well shaped die when the set-up is made. A satisfactory method of checking the dies must be established and followed. Wire breakage, scratches, crowfeet and other troubles some times experienced with composites are many times charged to the lubricant or the wire without any assurance that the die is even close to the proposed contour.

★ ★ ★

It is not intended in this article to propose, or suggest, the optimum angles to be used for various types of wire. However, it can be stated that the shape of the die is very critical when composite metals of different plastic deformation and work hardening characteristics are being cold drawn.

★ ★ ★

A wide entrance angle with a small blended radius will have a tendency to flake a soft surface metal on a relatively hard base metal. A wide angle with a short bearing will also check the surface plate as though it had little or no ductility[8].

Annealing

Proper heat treatment of wires composed of more than one metal offers a challenge to our knowledge of the most advanced techniques. Each metal will respond to elevated temperatures in a manner peculiar to its own composition. The recovery and recrystallization temperature will vary within each metal of a composite depending upon its previous cold reduction history. Restoring ductility for further reduction becomes a problem of selecting the

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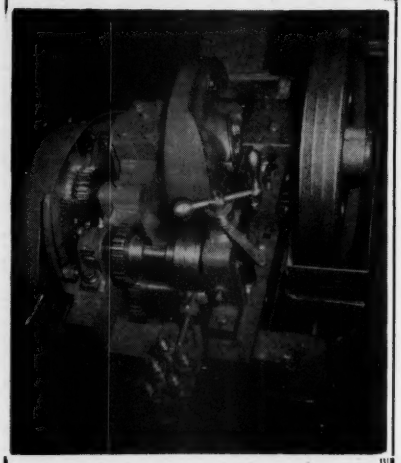

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proper annealing temperature for the metals present in the composite. The lowest temperature should be employed which will restore ductility to the higher melting metal. In certain cases, it may be necessary to use a temperature slightly lower than optimum at the sacrifice of some workability when widely divergent metals are bonded together. For example, nickel plated on low carbon steel is usually heated to 1350 to 1400°F. to insure ductility of the nickel while the steel alone could be annealed at a lower temperature.

★ ★ ★

With reference to annealing equipment, plated composite materials can be successfully annealed using strand, batch or belt type furnaces. No special furnace equipment is required if the rules of good furnace practice are exercised.

★ ★ ★

It is advisable, however, to use protective atmospheres to prevent scaling and possible loss of plating thickness.

Summary

Processes which plate large diameter rod or wires have been used successfully to plate many different combinations of metals and alloys on a variety of base materials, such as nickel on steel, cooper on steel, nickel on copper, copper on nickel, silver on nickel, silver on copper, brass on steel and copper on stainless steel.

★ ★ ★

Such plated materials yield many products which have the following advantages:—

1. **Uniform coating.**
2. **Well bonded coating.**
3. **Combined properties of several metals.**
4. **Corrosion resistance.**
5. **Good workability (can be drawn, bent, flattened, swagged and threaded by rolling).**
6. **Replacement of scarce or expensive materials.**

★ ★ ★

Electroplated composites have found applications in the fields of power transmission, jewelry manufacture, appliance manufacture, electronics' lighting as well as the manufacture of kitchen utensils, belts, screens, racks, springs, brac-

SAME CHILD, NEW PARENTS

NELCO

It wasn't so long ago that NELCO grew up and we proudly announced to the world that our lacquer had been christened with that name. We mentioned the many sides to NELCO's character such as the NELCO for vinyl insulated hook-up wire, the NELCO for electrical tubing, the NELCO for aircraft low tension wire, and many others.

We have been most pleased by the market's reception of NELCO. As NELCO continues to grow and diversify, we're sure our customers will be increasingly interested in its many possibilities.

To facilitate NELCO's growth and ease the parental discipline, the former parents, New England Lacquer Company, have combined their efforts with the Chemical Products Corporation. There will be no compromising of manufacturing standards. In fact, it's still the same child—with new parents.

The NELCO name will be retained and so will the famous NELCO trademark shown above. And your problems with cable coatings and saturants will be tackled by an increased staff working with greater facilities. We welcome the toughest problems you have.

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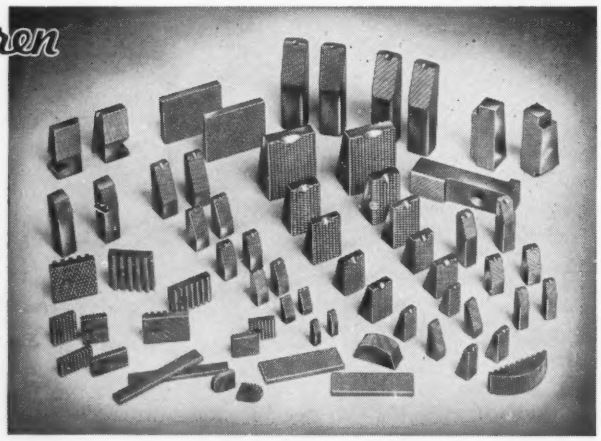

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kets and many other products.

★ ★ ★

Stimulated by both military and industrial needs, electroplating methods have made rapid progress within the past ten years. There is no doubt that the new demands for materials with improved electrical, corrosion resistant, strength and other properties at high and low temperatures will continue to maintain constant pressure on the producers of composite metals by electroplating.

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New Electric Motor Catalog

A new multi-color booklet illustrating the 20 principal types of improved U. S. motors has just come off the press. The illustrations are in natural color and include the following types — Uniclosed, Totally-Enclosed, Explosion-Proof with and without fan, Varidrive, Syncrogear, combination variable speed and internally geared units, Right-Angle Worm Gear, Verticlosed Hollowshaft, Vertical Solid Shaft, Test Stands and Aircraft. Cut-open views of Varidrive and Syncrogear types are shown in full color. Also included are AutoStart Buffers, Right-Angle Hollowshaft Gear Drive for turbine pumps, and interesting details on Lubriflush transverse bearing lubrication, asbestos-protected windings and normalized motor castings. Views of U. S. Motors' Atlantic and Pacific plants are reproduced in color. This new and highly interesting booklet may be obtained by writing to **U. S. Electrical Motors Inc.,** Box 2058, Los Angeles 54, Calif. Ask for booklet 1878.

Rigid and Semi Rigid PVC Insulations

(*Continued from page* 1333)

ally, basic lead carbonate, which is by far the most common stabilizer for opaque, flexible, vinyl compounds, is replaced by one of the better high temperature stabilizers such as dibasic lead phthalate, dibasic lead phosphite or basic silicate of white lead. Consideration must, of course, be given to the plasticizer used when a choice of stabilizer is made.

★ ★ ★

The normal fillers, colors, etc. which are used in flexible materials can also be used in the semi-rigids.

★ ★ ★

Semi-rigid wire insulations have certain very definite advantages over what are now considered to be standard materials.

★ ★ ★

These harder stocks are tougher in all respects — better abrasion resistance, better deformation characteristics and all around better resistance to mechanical abuse. These factors, while extremely important in themselves, offer very definite cost advantages because of the possibilities of thinner wall with otherwise equivalent properties. The implications here are very broad — lighter harness assemblies for planes more wires in the same size conduits, etc.

★ ★ ★

The improved electrical properties — because of reduced plasticizer content — will give equivalent electricals with the thinner walls.

★ ★ ★

The semi-rigid compounds — while somewhat stiffer — will have better low temperature properties than the ordinary flexible compounds. This type of compound has passed mandrel wrap tests in our laboratories at temperatures as low as —85°F.

★ ★ ★

The only major disadvantage of the semi-rigid materials is the increase in stiffness. This should not be too objectionable except in

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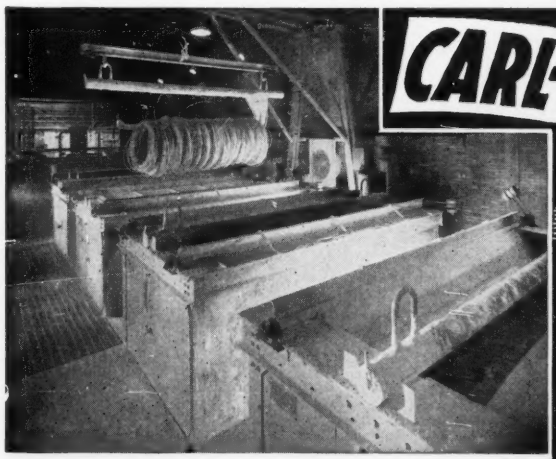
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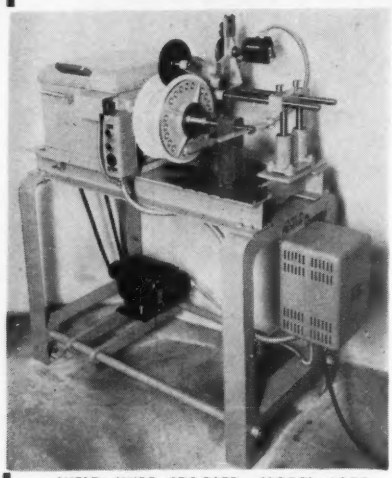
SPOOLER FOR WELD WIRE



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is designed for the thread layer winding of weld wire. The traverse mechanism is a single screw solenoid actuated for positive "No-dwell" reversing running in a constant shower of oil. Traverse lengths are easily adjusted from one-half to eight inches or longer if desired. Therefore, this machine can be used for other winding requirements.

Ball bearings throughout give free running and long life to all wear points.

Predetermining counter and measuring device provide automatic stop of wind at desired footage and hand operated clutch allows manual control.

The tailstock has a quick release action either hand or foot controlled.

The machine is powered by a motor with control for slow starting.

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the case of very flexible cords.

★ ★ ★

The properties of this classification of materials indicate a widespread field of interest and application. Some which suggest themselves, are the following:

1. **High temperature appliance wire —we feel that the properties of these materials will ultimately lead to 125°C wires.**
2. **High temperature hook-up wires.**
3. **Replacement of normal vinyl insulation plus nylon jackets where the nylon is used primarily for abrasion resistance.**
4. **All regular cord and wire applications where flexibility is not a major factor.**

★ ★ ★

I think you will now be interested in the results of some of our laboratory tests on these semi-rigid compounds.

★ ★ ★

Table I will show a comparison of a typical flexible 105°C compound and a semi-rigid 105°C compound.

★ ★ ★

The data given in Table I indicates this compound should be suitable for MIL-W-16878A, NAS-702, MIL-W-5086 (with 105°C modifications), as well as for 105°C appliance wires.

★ ★ ★

Additional data on a semi-rigid compound similar to compound "B" was obtained in comparison with a typical TW compound.

★ ★ ★

All other results, flame resistance, aging, etc. for this semi-rigid compound are similar to these listed for Compound "B" in Table I.

★ ★ ★

In abrasion tests, the semi-rigid compounds have passed the test specified in MIL-W-5086 as a test for nylon. In other tests, the abrasion resistance has been 50 or a hundredfold that of a typical TW compound.

★ ★ ★

In summary, we have presented properties and processing conditions for semi-rigid compounds. The processing variations should be easily accomplished in the average wire and cable plant.

★ ★ ★

The properties of these semi-

rigid materials offer use for such applications as:

1. **High temperature appliance wire**
2. **High temperature hook up wire**
3. **All regular cord and wire applications where flexibility is not a major factor.**

Specifically, the compounds of this type should meet requirements of MIL-W-16878A, MAS-702 and MIL-W-5086 (with 105°C. modifications).

Uses of Steel Wire Growing

(*Continued from page* 1336)

This company has long produced quality spring wire, including low, medium and high carbon, and alloy; MB hard drawn; and oil tempered. It has a good reputation for production of quality ACSR core wire for cable, welding wire, rope wire, cold heading wire, flat and shaped wire, rivet wire, screw wire, and nails. Its fabricated products include a full range of farm and lawn fence, chain link fence and welded wire fabric for construction purposes.

★ ★ ★

This year, by virtue of a recently completed four-year $65 million expansion and modernization program, our company has placed itself in a position to make better quality wire than ever before. This combination of experience and modern facilities enables us to supply the kind of wire United needs for its ever broadening line of formed wire products.

Bulletin for Wire Rope Users

Of interest to those who handle, use, and deal in wire rope is a new Macwhyte bulletin number 5448 called "Ropeology". Free copy is available by writing to **Macwhyte Company,** Advertising Department, Kenosha, Wisconsin.

★ ★ ★

In this new release are shown special boat slings, barge tow line, logging operation, cable assemblies, slings, and aircraft cable used on new super 18 Beechcraft and Boeing Jet Stratotanker.

★ ★ ★

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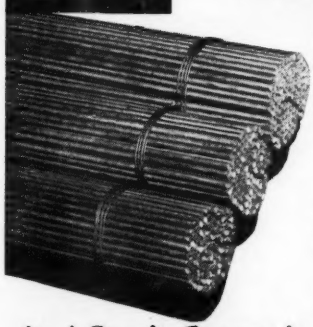

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send a copy of this and future bulletins to anyone handling, buying, or dealing in wire rope products.

Develop New Asbestos-Glass Tape for Cable Applications

Raybestos-Manhattan, Inc. has combined Fiberglas yarns and asbestos spinning fibre to make new tapes for cable insulation applications. According to **J. A. Bettes, Jr., Owens-Corning Fiberglas Corporation's** Textile Sales Manager, these tapes are examples of the effective "marriage" of Fiberglas and asbestos, as the resultant products retain the best characteristics of each material. They are superior in some respects to the all-asbestos materials they replace and are less costly to use. Recommended applications for various constructions of these new tapes and their advantages are listed below.

★ ★ ★

Novabestos No. 7503 is used in the belt or fire wall of shipboard cables. The Fibreglas reinforcing yarns provide a tensile of 95 pounds per inch of width minimum. This enables the cable manufacturer to operate his taping heads at maximum tension, and in so doing bind together the various components of the cable. This materially aids in passing the Navy's water leakage test.

★ ★ ★

Novabestos No. 7504 is designed for use as primary insulation over bare conductor in shipboard cables. It is adequately strong for this purpose, but it is not recommended for use as a belt. This type is also used as strap insulation in the winding of transformer coils.

★ ★ ★

Novabestos No. 7505 asphalt impregnated tape is used primarily in the manufacture of AVA and AVC type cables. The combination of asbestos, glass and asphalt provides as nearly rot resistant a combination as possible. It sells for about twice the price of asbestos roving but nevertheless produces a more economical cable. This is because an asbestos felting must be saturated, then taken to an oven to be dried, and then returned to

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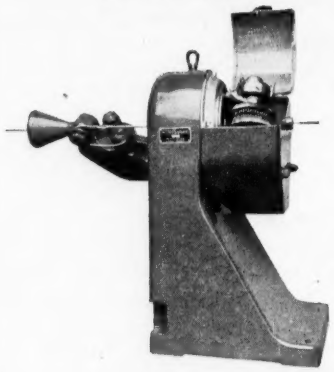

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the cable machine for additional processing. This tape enables the designer to provide a saturated wall, using taping heads, and to more nearly complete the cable in one operation. Even if additional operations are to be performed at the cable machine, there is still a saving in drying expense, and routing through the plant.

★ ★ ★

Three new Pyrotex tapes, of two layers of asbestos felt with a glass cloth between, are now available for essentially the same applications. They are Nos. 9519, 9520 and 9521. These tapes are strengthened by glass yarns both lengthwise and crosswise. The Fiberglas filling yarns will prevent or reduce lengthwise cracks in the taped insulation produced by the Navy's severe cold bend test. Pyrotex tapes, glass cloth reinforced, can be applied with any amount of register without cracking the edge of the tape.

New Cathodic Protection Cables

A major headache today to utilities, industrials and especially pipe line companies is the corrosion of buried metallic structure. The problem looms so large that many companies in these industries have established separate Corrosion Engineering Departments to handle efforts to combat its inroads.

★ ★ ★

Anaconda Wire & Cable Co. has cooperated with these industries on this problem and have developed and placed on the market a Type CP direct burial cable which, when used in the Cathodic Protection equipment, has been found extremely effective in installations for oil, pipe line, industrial and utility concerns.

★ ★ ★

The CP cables are available in sizes #8 through 4/0, single conductor, 600 V and can be either: a) a rubber-neoprene construction or b) all-plastic polyethylene insulation and red PVC jacket.

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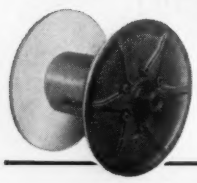

Having trouble with light weight reels failing in heavy duty service? Send us a sketch or print stating the limiting dimensions and service required, we'll be glad to tell you about our facilities for supplying the wire rope and cable industry with special heavy duty processing reels, spools or bobbins. WRITE FOR BULLETIN 52-W.

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DESIGNERS – ENGINEERS – MANUFACTURERS
MILTON • PENNA.

the 9 Answers to the Question" has been issued by **Carboloy Dept., General Electric Company,** Detroit, 32 Mich., in which are listed nine points of superiority of Carboloy wire dies. This bulletin, the new price list D-134 and the die catalog D-130 will be sent by the company upon request.

★ ★ ★

Another bulletin, recently issued gives the case histories on Carboloy lamination dies and dies for drawing and blanking bottle closures is also available.

New Catalog on Forming Machines

A new illustrated booklet describing a line of standard automatic ribbon metal four-slide machines has been issued by **Baird Machine Co.,** 1700 Stratford Ave., Stratford, Conn.

★ ★ ★

These machines have been developed from many years of experience in designing and building machines to produce a wide variety of articles from narrow strip and wire.

★ ★ ★

The process of forming products from ribbon metal differs somewhat from wire forming, so the forming slide cams have relatively long strokes, but at extra cost these same machine can be equipped to handle wire.

★ ★ ★

Photographs of machines and detailed parts, with cut-away line drawings, together with text, describe the operation of the machine fully. A specification table is included.

★ ★ ★

A copy of the catalog may be obtained from Baird upon request.

Bulletin on Industrial Lubricants

Gredag, Inc., Niagara Falls, N. Y. has issued a bulletin entitled "Service Recommendations for Industrial Lubricants" in which are described 17 lubricating greases as to grade, consistency and applications. These include mineral oil and synthetic greases, graphited and plain. Copies of the bulletin will be mailed upon request.

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Decreases down-time and replacement cost.

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New Haven, Connecticut

New Spiral Nail Catalog

The Steel Company of Canada, Ltd., Hamilton, Ont., Can., has issued a booklet on the new "Ardox" spiral nails that are threaded from point to shank. The nail and the process by which they are made is a development of Stelco as a result of extensive research.

★ ★ ★

The new nail is offered in the price range of ordinary nails. They are produced in common nail sizes and are said to make stronger joints and reduce the cost of both nails and nailing, since there are more nails to the pound, they have greater holding power, they require less driving force and they will not split wood as readily as the round nail.

★ ★ ★

An opening section entitled "Nails—Past and Present" gives a little historical background on nail making and discusses various devices employed by nail makers to make nails hold better.

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For FREE CUTTING of wires, cable, rods, baling wire and bolts up to medium hardness.

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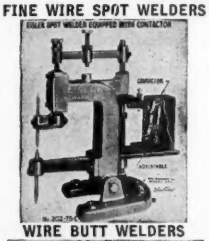

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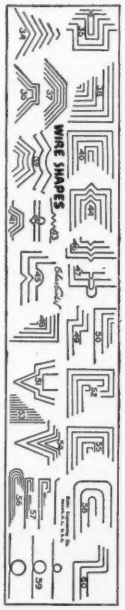

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The advantages of Ardox nails, that are produced by a fundamentally new manufacturing process, is considered to be a major advance in nail-making technique.

Makes New Heavy Torsion Winder

The Torrington Manufacturing Co.'s Machine Division, producer of spring coiling machines, has announced initial production of a heavier torsion spring winder capable of handling up to ten turns of .080-inch wire and featuring a larger tooling area than any comparable machine.

★ ★ ★

Officials of the Torrington, Conn., firm said that, although the new winder primarily was designed to overcome certain other shortcomings in existing equipment, room in which to work is proving to be the new machine's most appreciated feature. Weighing 1300 pounds, the winder's base measures 34″ by 38″.

★ ★ ★

The 12 by 18-inch tooling area of the new machine—designated the W-3001—provides sufficient room for faster set-ups, sturdier tools and enough space to keep the tools out of the way of swinging wire ends. The wire capacity of the new machine—equipped with

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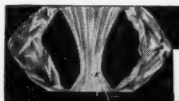
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shafts on three sides and a specially designed verticle two-slide attachment—meets the great majority of industry requirements for torsion springs.

★ ★ ★

Driven by a motorized variable speed transmission and V-belt drive, the W-3001 is equipped with two sizes of slide feeds: one handling up to 3-½ inches of wire and the second feeding wire ranging up to 6-¼ inches in length.

★ ★ ★

The winder's tool slides include two horizontal units, one right and one left-handed, and a vertical two-slide attachment which is available for use with the horizontal slides. Additional horizontal slides—coupled with shafts on three sides of the tool area—permit the production of various and complex wire forms.

★ ★ ★

The W-3001 winders are equipped on delivery with gears for 10 and 24 turns of the spindle. A set of gears for 47 turns of the spindle

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Also, a full line of carbide tooling for the Cold Heading Industry
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is also available. The number of turns within those ranges can easily be adjusted with the crank gear.

Firth-Loach In Production

Production in the new plant of **Firth-Loach Metals, Inc.,** McKeesport, Pa. is now under way. .

★ ★ ★

Following informal ceremonies on October 6th, the first Firlomet carbide was made and regular production operations began.

★ ★ ★

All equipment is the most modern of its type much of it having been designed and built for the new company's specific use, as a result of which, some of the production techniques will be new in the industry, company officials state.

★ ★ ★

The company does not plan to make any finished products, but will supply tool and die makers with blanks and nibs for fabrication.

Adamas Appoints Harper for Ohio Territory

Adamas Carbide Corp., Kenilworth, N. J., maker of standard carbide tools, tool tips, dies and wear parts, has appointed **William C. Harper,** Cincinnati, as its sales representative for southern Ohio and eastern Kentucky.

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WHERE TO BUY

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.
Only advertisers who have contracted for six or more insertions are listed in this section.

ABRASIVES—
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Norton Co., Worcester, Mass.

ACID INHIBITORS—
(See Inhibitors, Pickling)

ACID-PROOF CONSTRUCTION—
Ceilcote Company, Cleveland, Ohio
Chemical Construction Co., Pittsburgh, Pa.
Haveg Corporation, Newark, Del.

ALLOYS—Hardsurfacing Capstans, etc.
Parkway-Kew Corp., Menlo Park, N. J.

ANNEALING MACHINES — Electric Resistance
Synerc Machine Co., Perth Amboy, N. J.
Trauwood Engr. Co., Cleveland, O.

ANNEALING POTS AND BOXES—
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.

BAKERS—
(See OVENS—Rod Bakers)

BOBBINS—Braider & Wire Weaving
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket. R. I.

BORAX—Wire Drawing
Pacific Coast Borax Co., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BUSHINGS—Machine
Lignum-Vitae Products Corp., Jersey City, N. J.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket. R. I.

CASTINGS—Wire Mill
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.

CEMENTS—Acid Proof
Ceilcote Company, Cleveland, Ohio

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CLEANERS—Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila., Pa.
Metal & Thermit Corp., New York, N. Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Parkin Chemical Co., The, Pittsburgh, Pa.
Standard Industrial Compounds Co., Chicago.

CLEANING & PICKLING EQUIP.—
Ceilcote Company, Cleveland, Ohio
Chemsteel Construction Co., Pittsburgh, Pa.
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corporation, Newark, Del.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio
Youngstown Welding & Eng'g Co., Youngstown, Ohio.

CLOTH—WIRE, All Metals
Chase Brass & Copper Co., Waterbury, Conn.
Wickwire Bros., Cortland, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y
Standard Industrial Compounds Co., Chicago

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.
Miller, R. H. Co., Inc., Homer, N. Y.

COMPOUNDS—Diamond (Pre-Mixed)
Eastern Carbide Corp., New Rochelle, N. Y.
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago.
United States Industrial Diamond Corp., New York, N. Y.

COMPOUNDS—Extrusion, for Wire
(See COMPOUNDS—Vinyl)

COMPOUNDS—For Improving Drawing and Extrusion
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Metal & Thermit Corp., New York, N. Y.

COMPOUNDS—Phosphate Coating
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
American Lanolin Corporation, Lawrence, Mass.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago.

COMPOUNDS—Vinyl, for Wire
Electronic Rubber Co., Stamford, Conn.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Cook's Sons, Inc., Adam, Linden, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Pacific Coast Borax Co., New York, N. Y.
Standard Industrial Compounds Co., Chicago.
Swift & Company, Chicago, Ill.

CONDUCTORS—Flexible, Electrical
Montgomery Co., The, Windsor Locks, Conn.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Mach'y, Inc. (used) Pawtucket. R. I.

CORDS—Electrical, Tinsel Conductor
Montgomery Co., The, Windsor Locks, Conn.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Metal Carbides Corporation, Youngstown, Ohio
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Utica Drop Forge & Tool Corp., Utica, N. Y.
Vascoloy-Ramet Corp., Waukegan, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

CUTTING TOOLS—Wire
Porter, H. K. Inc., Somerville, Mass.

DESCALING PROCESS—Sodium Hydride
du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Fisher Associates, New York, N. Y.

DIAMONDS—Industrial
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Molina Industrial Diamond Co., New York, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
United States Industrial Diamond Corp., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Danforth, The C. W. Co., Youngstown, Ohio
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Indiana Wire Die Co., Ft. Wayne, Ind.
Industrial Diamond Powders, Pittsburgh, Pa.
Molina Industrial Diamond Co., New York, N. Y.
National Research Company, St. Clair Shores, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
United States Industrial Diamond Corp., New York, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDER RECLAIMING—
Danforth, The C. W. Co., Youngstown, Ohio
Industrial Diamond Powders, Pittsburgh, Pa.
Kay & Warren Co., Brooklyn, N. Y.
National Research Co., St. Clair Shores, Mich.
Molina Industrial Diamond Co., New York, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DIAMOND TOOLS—
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Carbide, Tungsten & Tantalum
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., New York, N. Y.
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Cold Heading
Carboloy Dept. of General Electric Co., Detroit
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio
Vascoloy-Ramet Corp., Waukegan, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Cochaud Wire Die Inc., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Molina Industrial Diamond Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
North American Philips Co., Inc., Elmet Div., Lewiston, Me.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES—Extrusion
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Metal Carbides Corporation, Youngstown, Ohio
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Eyelet
Eastern Carbide Corp., New Rochelle, N. Y.
Kelly Wire Die Corp., New York, N. Y.

DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc, New York, N. Y.
Carboloy Dept. of General Electric Co., Detroit.
Cochaud Wire Die Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Ft. Wayne Wire Die., Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
New England Wire Die Co., Worcester, Mass.
North American Philips Co., Inc., Elmet Div., Lewiston, Me.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wayne Wire Die Co., Hillside, N. J.

DIES—Special Shapes, Etc.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Swaging
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

DIES—Tube Drawing
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Vascoloy-Ramet Corp., Waukegan, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS & TRAVERSES—For Cable Reels
Hubbard Spool Co., Garrett, Ind.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

DRYING EQUIPMENT
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio.
Michigan Oven Co., Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.

ENGINEERS—Consulting
Lubricants—Hans C. Bick, Inc., Reading, Pa.
Wire Mill—Clarence S. Arms, Worcester, Mass.
Seymour, Leroy D., Trenton, N. J.
Zinc—Imhoff, Wallace G. Co., Los Angeles, Calif.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FENCING & FENCES—Wire
Interlocking Fence Co., Morton, Ill.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio
Harper Electric Furnace Corp., Buffalo, N. Y.
Rockwell, W. S. Co., Fairfield, Conn.

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio
Trauwood Engineering Co., The, Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Drever Company, Phila., Pa.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio

FURNACES—Pot (oil, gas, electric)
Ajax Electric Co., Inc., Philadelphia, Pa.

FURNACES—Resistance Heating, Strand
(See Annealing Machines)

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio

GALVANIZING EQUIPMENT — (See MACHINERY—Galvanizing Wire)

GRINDERS—Roll
Norton Co., The, Worchester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.
Lignum-Vitae Products Corp., Jersey City, N. J.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HARDSURFACING ALLOYS—
(See Alloys—Hardsurfacing)

HOOKS—Pickling & Liming
Youngstown Welding & Eng'g Co., Youngstown, Ohio

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INSULATING MATERIALS—
Celanese Corporation of America, New York, N. Y.
Chemical Products Co., E. Providence, R. I.
Electronic Rubber Co., Stamford, Conn.
Heineman Corp., Oscar, Chicago, Ill.
Libbey-Owens, Ford Glass Co., Fiber Glass Div., Toledo, Ohio
Merrimac Paper Co., New York, N. Y.

INSULATING MATERIALS — Paper—For Electric Wire Cable
Merrimac Paper Co., New York, N. Y.

LACQUERING SYSTEMS — See MACH.—Lacquering Electric Wire

LACQUERS—For Electric Wire
Chemical Products Co., E. Providence, R. I.

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS — For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Standard Industrial Compounds Co., Chicago.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany
Wean Engineering Co., Cleveland, Ohio

MACHINERY—Braiding
Fidelity Machine Co., Inc., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Wardwell Braiding Mach. Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Providence, R. I.
Federal Manufacturing Co., Wallingford, Conn.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Inc., Philadelphia, Pa.
Haskell-Dawes Machine Co. Philadelphia, Pa.
New England Butt Co., Providence, R. I.
New York Engineering Co., Yonkers, N. Y.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Machinery—Winding Wire)

MACHINERY—Centerless Grinding
Schumag Schumacher Metallwerke, Aachen, Germany.

MACHINERY—Chain Making
Cosa Corporation, New York, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

MACHINERY—Closing Rope
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Cold Heading
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
Aetna-Standard Engineering Co., Pittsburgh.
American Insulating Mach'y Co., Phila., Pa.
National Mach'y Exch. (Used), New York.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Crimping Wire
Cedar West Tool Co., New York, N. Y.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Utica Drop Forge & Tool Corp., Utica, N. Y.
Wean Equipment Corp., Cleveland, Ohio
Wells, Frank L., Co., Kenosha, Wis.

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Herborn, Germany.

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Carboloy Dept. General Electric Co., Detroit, Mich.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
International Wire Products Co., Midland Pk., N. J.
Kelly Wire Die Corp., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Electrode Grinding
Cosa Corporation, New York, N. Y.

MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, Ohio
International Wire Products Co., Midland Pk., N. J.
Michigan Oven Co., Detroit, Mich.
Rockwell Co., W. S., Fairfield, Conn.

MACHINERY—Extruding
Aetna-Standard Engineering Co., Pittsburgh.
Davis-Standard Sales Corp., Mystic, Conn.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Interlocking Fence Co., Morton, Ill.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Mettler Machine Tool, Inc., New Haven, Conn.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Forming Wire
Baird Machine Co., Stratford, Conn.
Nilson, A. H., Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

MACHINERY—Fourdrinier Looms
Cedar West Tool Co., New York, N. Y.

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Providence, R. I.
International Wire Products Co., Midland Pk., N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
Aetna-Standard Engineering Co., Pittsburgh, Pa.
American Insulating Mach'y Co., Phila., Pa.
Davis-Standard Sales Corp., Mystic, Conn.
Fidelity Machine Co., Inc., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Pourtier Père & Fils, Romainville, France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Mach. Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Inc., Philadelphia, Pa.

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia.
Cook Mfg. Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, O.
Michigan Oven Co., Detroit, Mich.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Cedar West Tool Co., New York, N. Y.
Interlocking Fence Co., Morton, Ill.
Mummert-Dixon Co., Hanover, Pa.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Baird Machine Co., The Stratford, Conn.
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

MACHINERY—Packaging Wire
Coulter & McKenzie Machine Co., Bridgeport, Conn.

MACHINERY—Pickling
Chemsteel Construction Co., Pittsburgh, Pa.
Youngstown Welding & Eng'g Co., Youngstown, Ohio.

MACHINERY—Pin Making
Baird Machine Co., The, Stratford, Conn.
Cosa Corporation, New York, N. Y.

MACHINERY—Pointing
Aetna-Standard Engineering Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used). New York.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury Conn.
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Poultry Wire Fencing
Interlocking Fence Co., Morton, Ill.
Wean Equipment Corp., Cleveland, O.

MACHINERY—Re-Spooling
Boyd & Sons Manufacturing Corp., Philadelphia, Pa.
Cedar West Tool Co., New York, N. Y.
Davis Electric Co., Wallingford, Conn.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
International Wire Products Co., Midland Pk., N. J.
Mummert-Dixon Co., Hanover, Pa.
National Mach'y Exch. (Used), New York, N. Y.
Steel Equipment Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, O.
Watkins Machine Shop, R. S., Sandy Hook, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

MACHINERY—Rod Mill
Morgan Construction Co., Worcester, Mass.
Schumag Schumacher Metallwerke, Aachen, Germany
Wean Equipment Corp., Cleveland, Ohio

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Sales Corp., Mystic, Conn.
Royle, John & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Fidelity Machine Co., Phila., Pa.
Pourtier Pere & Fils, Romainville, France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Spark Testing
Davis Electric Co., Wallingford, Conn.
Federal Manufacturing Co., Wallingford, Conn.
Peschel Electronics, Inc., New Rochelle, N. Y.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Spring Making
Carlson Company, The, New York, N. Y.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Staple
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt, Germany.

MACHINERY—Straightening & Cutting
Cosa Corporation, New York, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Medart Co., The, St. Louis, Mo.
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Stranding
Haskell-Dawes Machine Co., Philadelphia, Pa.
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Studmaking
Cosa Corporation, New York, N. Y.

MACHINERY—Swaging
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
Aetna-Standard Engineering Co., Pittsburgh, Pa.
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Sales Corp., Mystic, Conn.
Federal Manufacturing Co., Wallingford, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
International Wire Products Corp., Midland Park, N. J.
Michigan Oven Co., Detroit, Mich.
New York Engineering Co., Yonkers, N. Y.
Standard Mill Supply Co., Pawtucket, R. I.
Watkins Machine Shop, R. S., Sandy Hook, Conn.
Watson Machine Co., Paterson, N. J.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Pourtier Pere & Fils, Romainville, France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Testing Magnet Wire Coatings for Pin Holes
Peschel Electronics, Inc., New Rochelle, N. Y.

MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Michigan Oven Co., Detroit, Mich.
Steel Equipment Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
International Wire Products Corp., Midland Park, N. J.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill, Cold Drawing
Aetna-Standard Engineering Co., Pittsburgh, Pa.
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Co., Wallingford, Conn.
Edmands Company, The, Providence, R. I.
Federal Manufacturing Co., Wallingford, Conn.
Haskell-Dawes Machine Co., Philadelphia, Pa.
International Wire Products Corp., Midland Park, N. J.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot)

MACHINERY—Washer Forming
Cosa Corporation, New York, N. Y.

MACHINERY—Winding Wire
Cedar West Tool Co., New York, N. Y.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Newark, N. J.
Federal Manufacturing Co., Wallingford, Conn.
Michigan Oven Co., Detroit, Mich.
Mummert-Dixon Co., Hanover, Pa.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Pittsburgh, Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Herborn, Herborn, Germany
International Wire Products Corp., Midland Park, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Schumag Schumacher Metallwerke, Aachen, Germany
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watkins Machine Shop, R. S., Sandy Hook, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Baird Machine Co., The, Stratford, Conn.
Cosa Corporation, New York, N. Y.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Welded Wire Fabric
Maschinen & Stahl, A. G., Entwicklungs Verwertungs Gesellschaft, Switzerland

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem, Rolling & Edging
Wean Equipment Co., Cleveland, Ohio

NAIL TOOLING—Tungsten Carbide
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

NOZZLES—For Extruding Machines
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Michigan Oven Co., Detroit, Mich.
Rockwell Co., W. S., Fairfield, Conn.

OVENS—Rod Bakers
Carl-Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Michigan Oven Co., Detroit, Mich.

PAINT—Acid Proof
Ceilcote Company, Cleveland, Ohio

PAINT BONDING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAPER—Creped Wrapping
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Camden, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Camden, N. J.
Terkelsen Machine Co., Boston, Mass.

PATENT ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D. C.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PICKLING—Hooks, etc. Acid Resisting
Youngstown Welding & Eng'g Co., Youngstown, Ohio

PICKLING TANK LININGS—
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corp., Newark, Del.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

PLASTICS—for Wire Insulation
Electronic Rubber Co., Stamford, Conn.

PLIERS—For Wire
Utica Drop Forge & Tool Corp., Utica, N. Y.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

PRESSES—Hydraulic and Mechanical
Aetna-Standard Engineering Co., Pittsburgh, Pa.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Wean Equipment Corp., Cleveland, Ohio

PUMPS—Molten Metal
Fisher Associates, New York, N. Y.

REEL AND TENSION STANDS—
Davis Electric Co., Wallingford, Conn.
Fidelity Machine Company, Inc., Philadelphia
Industrial Ovens, Inc., Cleveland, Ohio.
New York Engineering Co., Yonkers, N. Y.
Roll-A-Reel, Cincinnati, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

REEL CRUTCHES—
Roll-A-Reel, Cincinnati, Ohio
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

REELS—Metal Bound
Durkee Mfg. Co., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., Wm., Westport, Mass.

REELS—Plywood
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., Wm., Westport, Mass.
Nelson Company, The, Baltimore, Md.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L. Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

McCaskie, Inc., Wm., Westport, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wooden
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Nelson Company, The, Baltimore, Md.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Co., Cleveland, Ohio
Crucible Steel Co. of America, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Steel
Crucible Steel Co. of America, Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Chase Brass & Copper Co., Waterbury, Conn.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Blocks
Madesco Tackle Block Co., Easton, Pa.

ROPE—Wire
American Steel & Wire Company, Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—
(See COMPOUNDS—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—Rust Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SODIUM—for Descaling
du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.

SPOOLS—(See Reels & Spools)

SPOOLS—Stamped Metal for Retail Wire Sales
Clark, J. L. Mfg. Co., Rockford, Ill.
Mason Can Co., East Providence, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

STRIPPERS—Wire, Electric
Utica Drop Forge & Tool Corp., Utica, N. Y.

TANKS—Compound
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling and Plating
Ceilcote Company, Cleveland, Ohio
Chemsteel Construction Co., Pittsburgh, Pa.

TESTERS — INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT
(See MACHINERY Testing, Physical and Diameter Testing)

TINNING PROCESS—
Metal & Thermit Corp., New York, N. Y.

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper, Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.

TOOLS—Welding Wire, Strip & Foil (Pressure)
Utica Drop Forge & Tool Corp., Utica, N. Y.

TOOLS—Wire Cutting
Porter, H. K. Inc., Somerville, Mass.
Utica Drop Forge & Tool Corp., Utica, N. Y.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRANSMISSIONS—Variable speed (See Machy—Power Transmission)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

VALVES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—for Electric Wire
Chemical Products Co., E. Providence, R. I.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Hoffman Co., Robt. W., Chicago, Ill.
Maschinen & Stahl, A. G., Entwicklungs Verwertungs Gesellschaft, Switzerland
Micro Products Co., Chicago, Ill.
Utica Drop Forge & Tool Corp., Utica, N. Y.

WIRE—Aluminum
Elmet Division, North American Philips Company, Inc., Lewiston, Maine
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Malin & Co., The, Cleveland, Ohio
Scovill Mfg. Co., Waterbury, Conn.

WIRE—Barbed
Interlocking Fence Co., Morton, Ill.

WIRE—Brass
Academy Metal Products Co., Hoboken, N. J.
Chase Brass & Copper Co., Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Spencer Wire Corp., Union, N. J.

WIRE—Brush
Spencer Wire Corp., Union, N. J.

WIRE—Bunched & Stranded, Copper
Camden Wire Co., Camden, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Co., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Camden Wire Co., Camden, N. Y.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind
Crucible Steel Co. of America, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Copper
Chase Brass & Copper Co., Waterbury, Conn.
Spencer Wire Corp., Union, N. J.

WIRE—For Electrical Conductors
Camden Wire Co., Camden, N. Y.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.

WIRE—Flat, Fine
Elmet Division, North American Philips Company, Inc., Lewiston, Maine
Montgomery Co., The, Windsor Locks, Conn.

WIRE—Galvanized
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Manufacturers
Academy Metal Products Co., Hoboken, N. J.
American Steel & Wire Co., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Worcester, Mass.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark, N. J.
North American Philips Co., Inc., Elmet Division, Lewiston, Me.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Corp., Union, N. J.
U. S. Steel Co., N. Y., N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Music
American Steel & Wire Co., Cleveland, Ohio
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio
Spencer Wire Corp., Union, N. J.

WIRE—Needle
Carpenter Steel Company, Webb Wire Division, New Brunswick, N. J.

WIRE—Nickel Alloy
Academy Metal Products Co., Hoboken, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Academy Metal Products Co., Hoboken, N. J.
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Malin & Co., The, Cleveland, Ohio

WIRE—Oil Tempered
Crucible Steel Co. of America, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Silver Plated Copper
Camden Wire Co., Camden, N. Y.

WIRE—Special Shapes
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Crucible Steel Co. of America, Pittsburgh, Pa.
Continental Steel Corp., Kokomo, Ind.
National Lock Washer Company, The, Newark, N. J.

WIRE—Spring
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
Academy Metal Products Co., Hoboken, N. J.
American Steel & Wire Co., Cleveland, Ohio
Carpenter Steel Company, Webb Wire Div., New Brunswick, N. J.
Crucible Steel Co. of America, Pittsburgh, Pa.
Firth Sterling, Inc., Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE—Steel—Also Coppered and Galvanized Steel
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N J.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Corp., Union, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Tinned Copper
Camden Wire Co., Camden, N. Y.

WIRE—Tungsten
North American Philips Co., Inc., Elmet Division, Lewiston, Me.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARNS & TAPES—Insulating
Celanese Corporation of America, New York, N. Y.
Heineman Corp., Oscar, Chicago, Ill.
Libbey-Owens-Ford Glass Co., Fiber Glass Div., Toledo, Ohio.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON 3, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE AND MASTICATING MACHINERY MANUFACTURERS

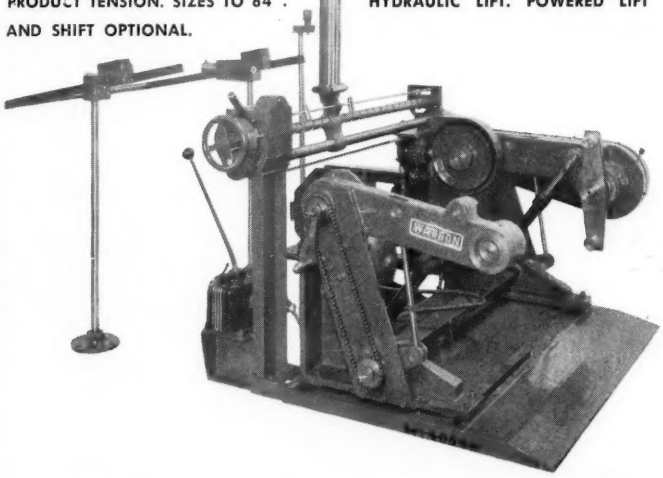
WATSON

EXTRUDER TAKEUPS

OFFERED IN A VARIETY OF SIZES AND DESIGNS OF WHICH THOSE SHOWN ARE EXAMPLES.

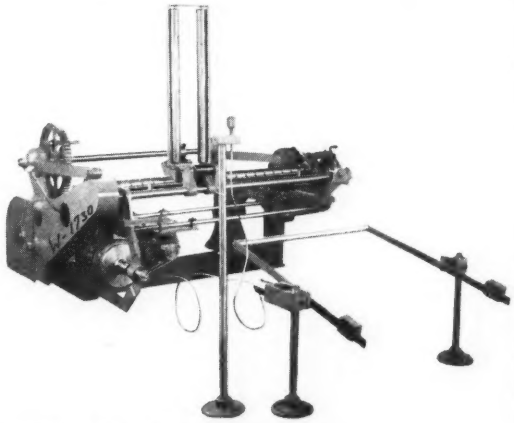
TYPE "H" - SHAFTLESS

NO. W-4054A SHOWS A SELF-POWERED 50" SIZE WITH TRAVERSE "CR" AND HYDRAULIC FLOAT ROLL CONTROL FOR WINDING WITHOUT PRODUCT TENSION. SIZES TO 84". HYDRAULIC LIFT. POWERED LIFT AND SHIFT OPTIONAL.



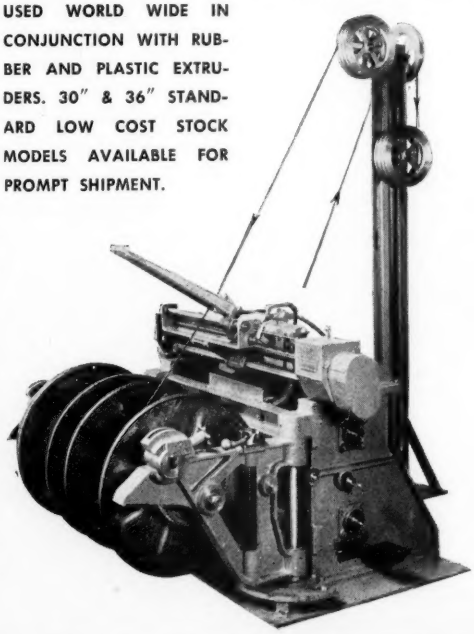
TYPE "W" - MECHANICAL LIFT

NO. W-1730 IS A SELF-POWERED 60" UNIT WITH TRAVERSE "RR" AND HYDRAULIC FLOAT ROLL CONTROL. FREE-ACTING HANDWHEEL MECHANIZED LIFT. AVAILABLE IN 6 SIZES FROM 30" TO 84" DIA. POWERED LIFT OPTIONAL.



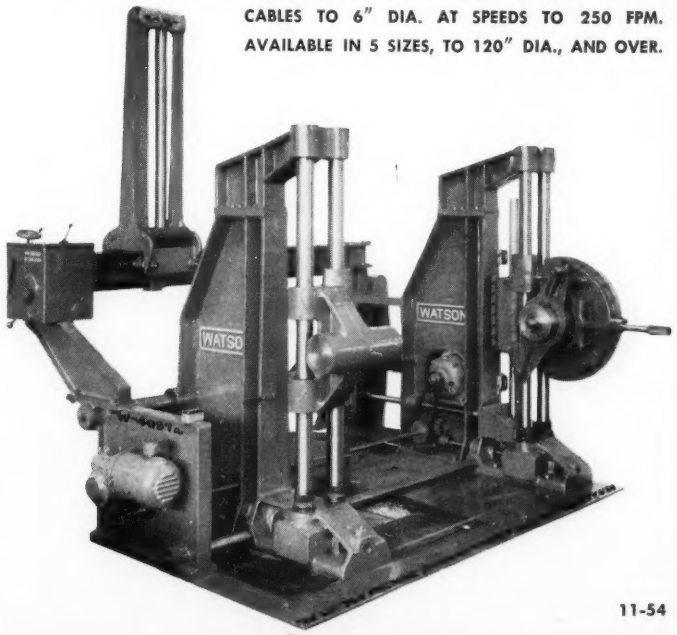
TYPE "DC" - CONTINUOUS

NO. W-1731A IS A 30" & 42" COMBINATION UNIT ARRANGED FOR DUAL REEL CONTINUOUS OPERATION. USED WORLD WIDE IN CONJUNCTION WITH RUBBER AND PLASTIC EXTRUDERS. 30" & 36" STANDARD LOW COST STOCK MODELS AVAILABLE FOR PROMPT SHIPMENT.

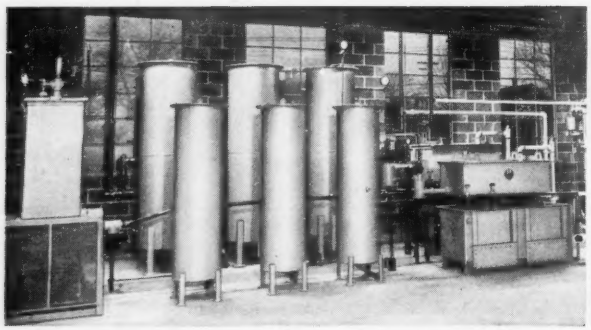


TYPE "V" - SHAFTLESS, FULLY MOTORIZED

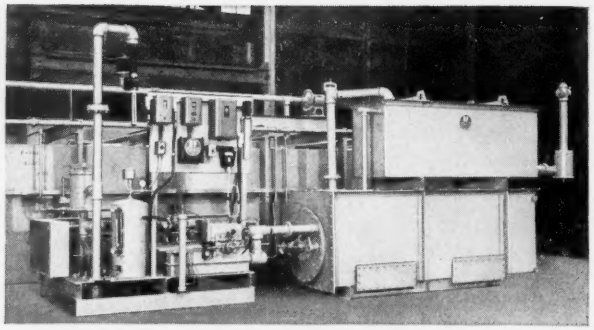
NO. W-4097A SHOWS A TAKEUP FOR HANDLING REELS FROM 48" TO 110" DIA. HAVING LOADS TO 10 TON, WITH TRAVERSE "WWR." WINDS CABLES TO 6" DIA. AT SPEEDS TO 250 FPM. AVAILABLE IN 5 SIZES, TO 120" DIA., AND OVER.



11-54



An EF installation consisting of a 1500 and a 3000 cfh exothermic horizontal water cooled type special atmosphere unit, each with desulphurizing towers and refrigerators for bright annealing steel and copper, and clean annealing brass.

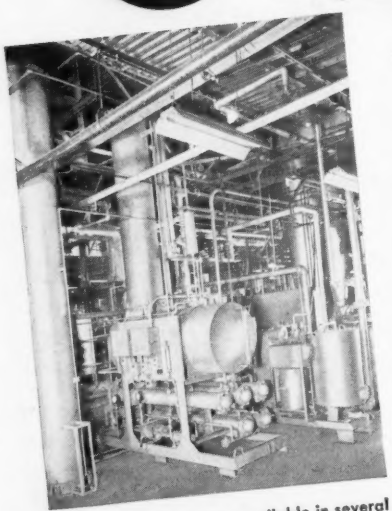


An EF kerosene exothermic gas generator. These are also built in several sizes and types for producing special atmospheres for use in bright annealing copper and steel products in areas where fuel gases are not available.

EF SPECIAL ATMOSPHERE EQUIPMENT

For any Heat Treating Process . . . any Capacity

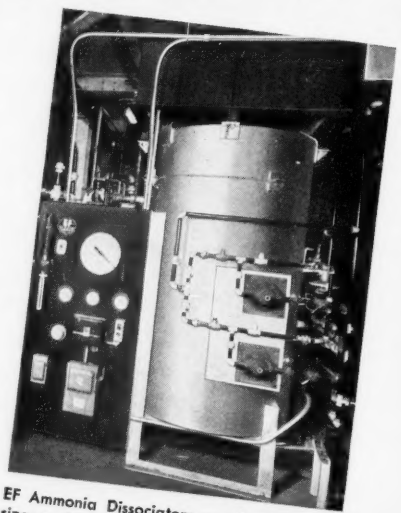
Long Experience = High Efficiency + Low Maintenance



Gas scrubbing units are available in several sizes and types for use with EF special atmosphere generating equipment where it may be necessary to remove CO_2 or H_2S.

• As pioneers in the development and use of equipment for producing low cost special atmospheres, we are in position to furnish a wide range of reliable, thoroughly tested special atmosphere units, including endothermic and exothermic gas generators, ammonia dissociators, refrigerators, dryers, desulphurizers, gas scrubbing units and other special atmosphere equipment — equipment with a reputation for high efficiency,— and low maintenance and operating costs.

Submit your furnace or special atmosphere problems to experienced engineers — *IT PAYS*

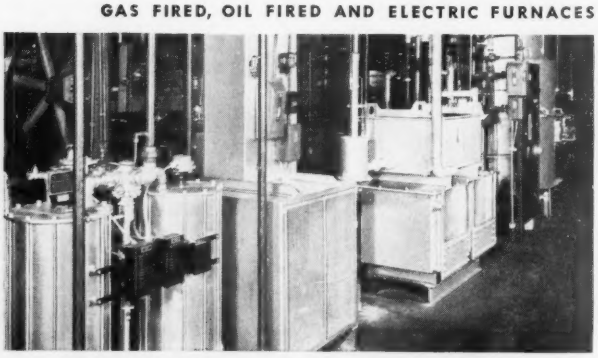


EF Ammonia Dissociators are built in many sizes and types for producing highly reducing atmospheres as required for bright annealing stainless; and other annealing and normalizing processes and preventing decarburization.

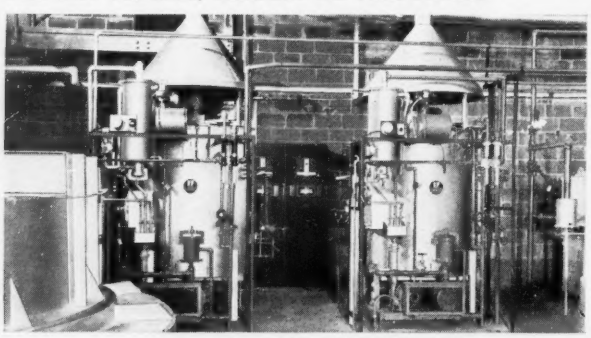
THE ELECTRIC FURNACE CO.

WILSON ST. at PENNA. R.R. *Salem - Ohio*

GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION



EF special atmosphere installation consisting of an exothermic generator, refrigerator and dryer as used with EF furnaces for bright and clean annealing ferrous and non-ferrous products.



An installation consisting of two small EF oil fired endothermic generators producing special atmospheres from propane for carburizing and other processes.